The Electrical Industry's Weekly Magazine June 22, 1959

Electrical World

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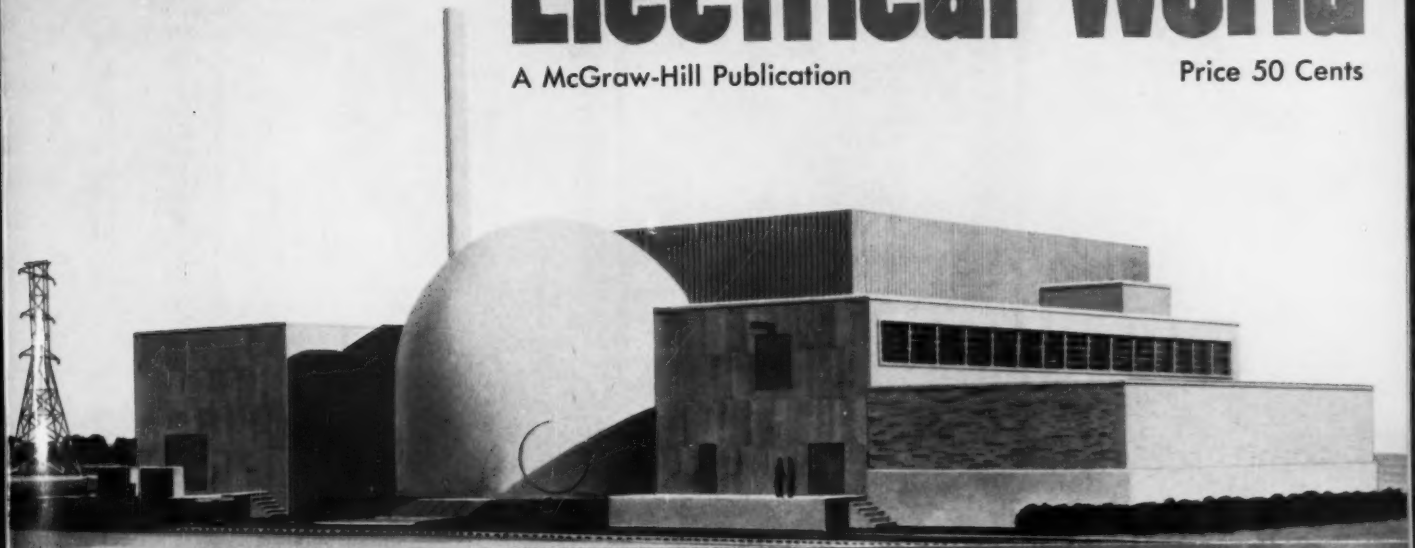

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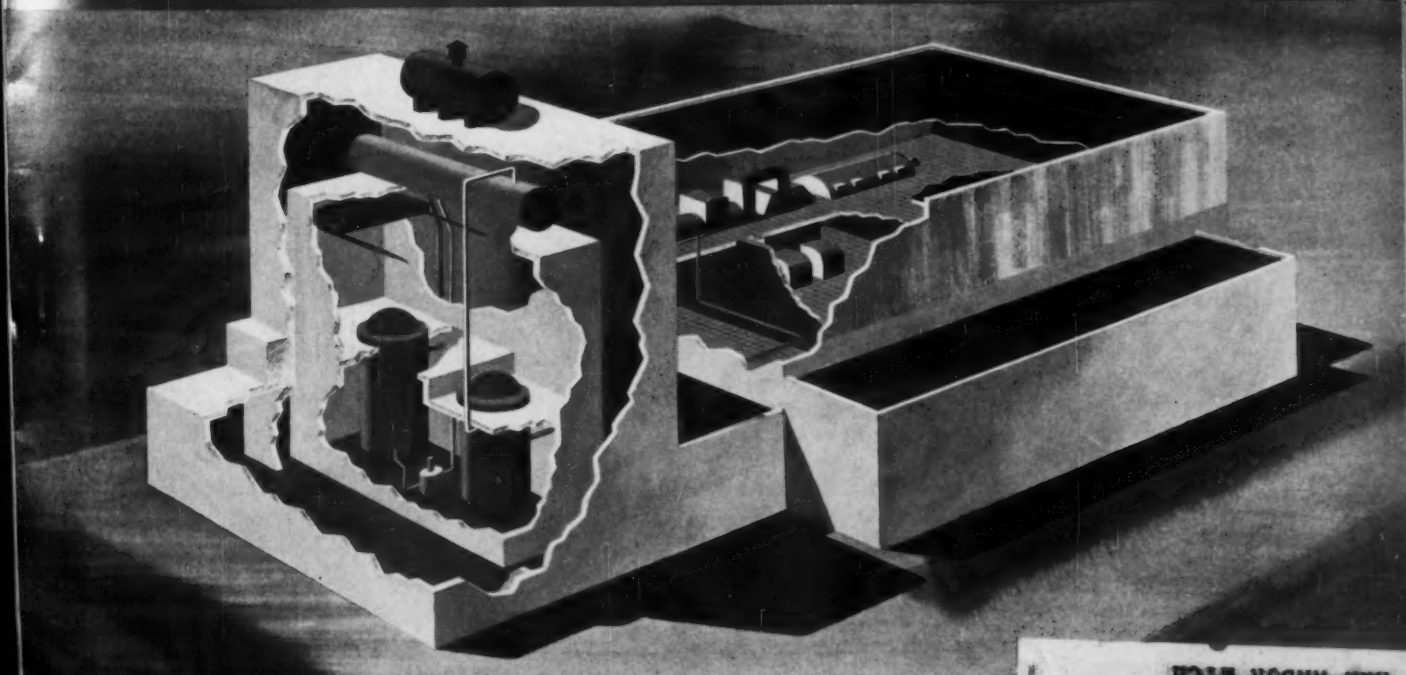

How Hard Would Steel Strike Hit Industrial Kwhr Sales? ...p 19

STEVENS ALICE GS W
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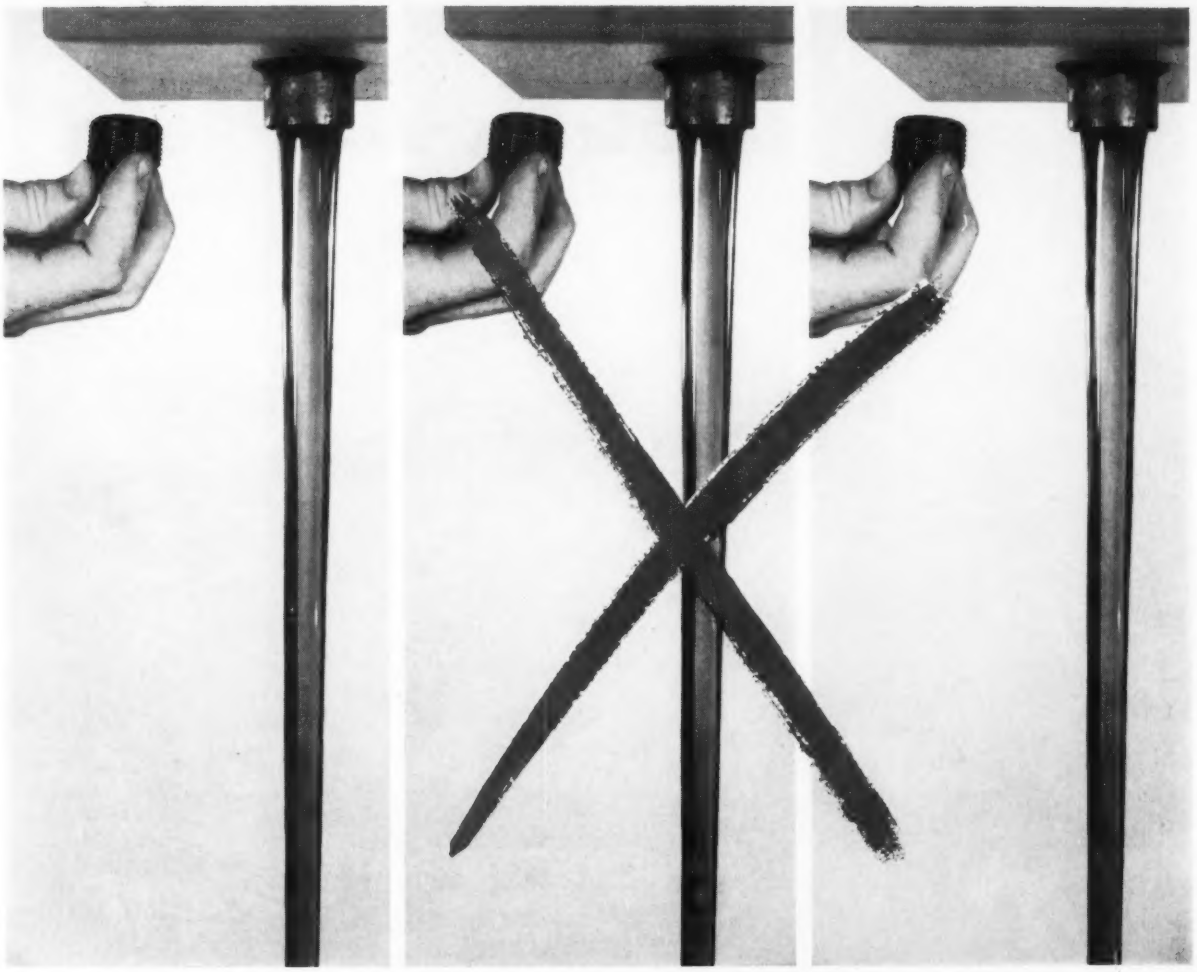

HOW TO CUT DRAIN PERIODS,
yet improve hydraulic performance!

Drain periods for a hydraulic system may be extended many times over by switching from straight mineral oils to a premium oil.

This has been proved time and again when the switch has been made to Texaco Regal Oil R&O without altering any other operating conditions.

It's obvious that draining hydraulic systems, cleaning, and replacing with new oil is costly. If one or more drainings can be eliminated the additional oil cost would be warranted.

Straight mineral oil may be satisfactory for some systems, but tests show that Regal Oil R&O can extend the interval between draining at considerable savings. This premium oil is formulated to resist oxidation, rust, foam, and wear.

And there's a bonus! When you do drain, you'll find the system in cleaner condition. Save again on make-ready.

The advantages of switching to Regal Oil R&O are so convincing that Texaco has made a film about it. We'll be happy to arrange a showing at your plant without obligation. Call the nearest of the more than 2,300 Texaco Distributing Plants, or write to:

Texaco Inc., 135 East 42nd Street, New York 17, N. Y.

CONSTANT PROGRESS IN OIL'S FIRST CENTURY

LUBRICATION IS A MAJOR FACTOR IN COST CONTROL

(PARTS, INVENTORY, PRODUCTION, DOWNTIME, MAINTENANCE)

Electrical World

Published for 85 years for those engaged in the business of generating, transmitting, distributing, or applying electric power

Vol. 151, No. 25 JUNE 22, 1959

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Petition to Block Imports Is Turned Down

Office of Civilian and Defense Mobilization rejects NEMA and GE arguments on hydro-electric equipment.....p 56

Network Helps France Meet Increased Demand

Conversions to 380-kv transmission bolsters links between daringly-designed hydro plants and load centers.....p 60

MANAGEMENT NEWSLETTER

How Hard Would Steel Strike Hit Kwhr Sales?

Study of past strikes indicates relatively little effect. But some things are different this time.....p 119

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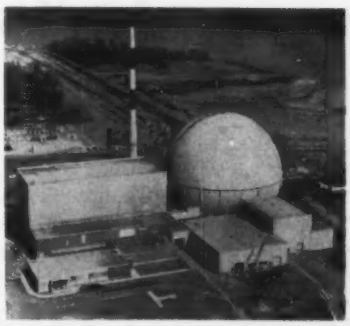

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Fourth Annual Nuclear Power Report

Here are fresh evaluations in terms of costs and timing for three of the major reactor types, and a fourth article on the significant new subject of nuclear superheat—along with vital statistics on power reactors in operation, under construction, and in planning stages.

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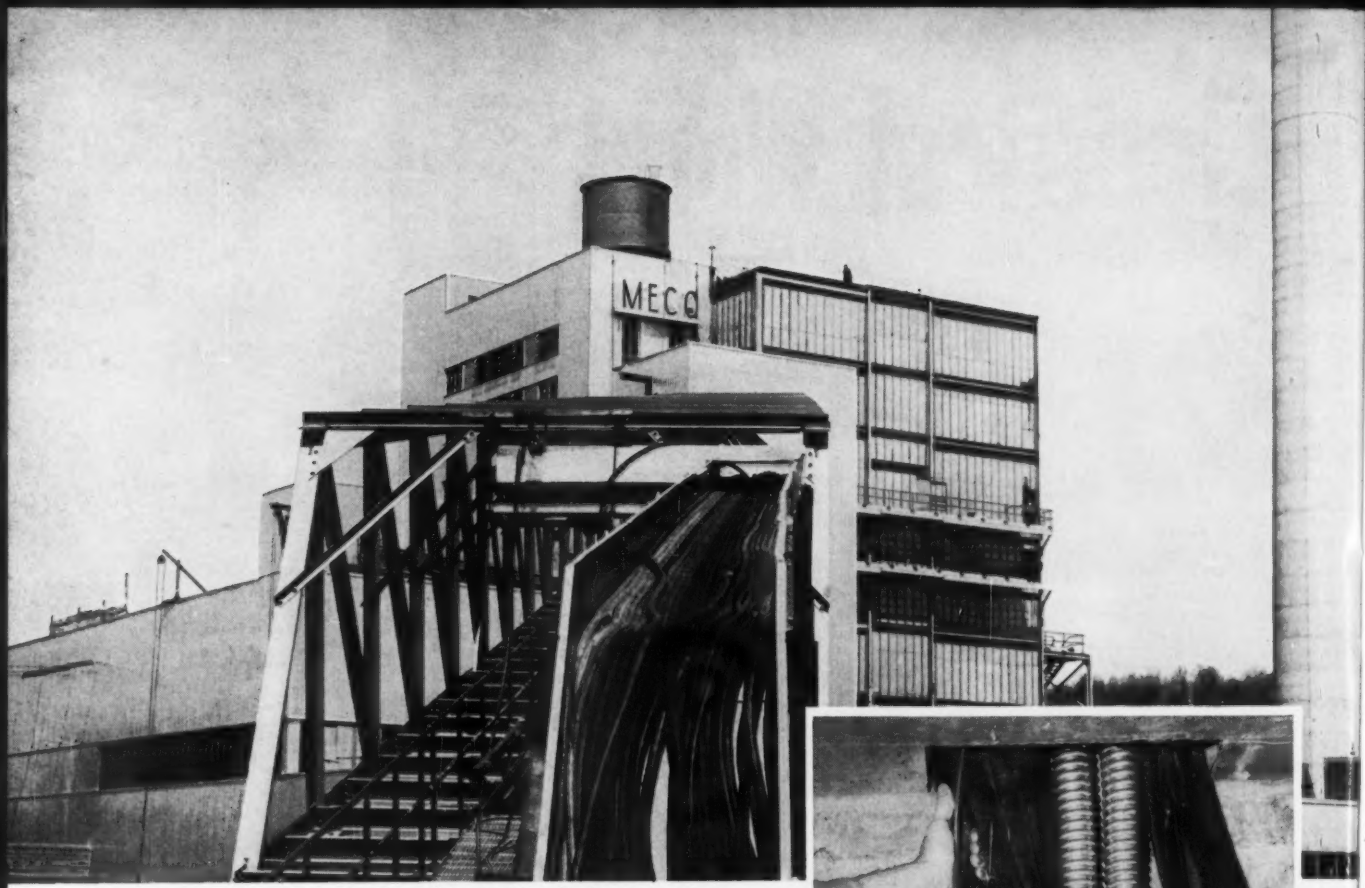

One construction, one basic cable design finds many uses. Open coal conveyor structure shown under construction above carries Okolite-Okoprene power and control cables from Metropolitan Edison Company's new Portland Generating Station to coal storage yard. Three types of the same cable meet in the tunnel (right) beneath the switching station: Okolite-Okoprene with CM-OT finish; Okolite-Okoprene with aluminum Loxarmor; Okolite-Okoprene with straight Okoprene sheath.

Another leading utility picks
Okolite-Okoprene for maximum margin of safety

Utmost reliability, proved by long-term service records, is the reason why Okolite-Okoprene was selected for the brand new Portland, Pa., Generating Station of the Metropolitan Edison Company—engineered by Gilbert Associates, Inc. Various Okolite-Okoprene cables have been installed for 600-volt power and control service with protective coverings designed for specific installation conditions. For example:

- **To avoid expense of conduit...permit quick addition of new circuits**...Okolite-Okoprene power cable with flexible aluminum Loxarmor, in trays, carries power to motors, pumps, coal conveyors, fans and practically all other operating equipment.

- **For maximum protection against soil corrosion, mechanical damage and insect attack**...Okolite-Okoprene control cable with Type CM-OT (corrugated bronze tape) finish is used for direct burial underground circuits to the switching station in the yard. Finish combines remarkable compressive strength with light weight and easy handling.

- **For great weathering strength and resistance to abrasion**... Okolite-Okoprene control cable with an overall Okoprene sheath is used for most other control circuits within station ...and installed in outdoor trays leading to coal storage yard.

Power stations from coast to coast rely on Okolite-Okoprene for vital power and control circuits—a testimonial to its dependability . . . its long life and dielectric strength . . . its resistance to corona cutting, moisture, heat, chemicals and mechanical damage. For further information on this premium quality cable, made by Okonite's exclusive strip-insulating process . . . and its adaptability to your important circuits, write for Bulletin EW-1085, The Okonite Company, Passaic, New Jersey.

***where there's electrical power... there's* OKONITE CABLE**

6358

The Electricity Keeps Going Off?

Just the other day we chanced to accompany an acquaintance in his quest for a new apartment in one of the nicer suburbs of a large Eastern city. Repeatedly, the new developments we examined were equipped with gas ranges. Our friend finally queried one landlady on the point.

"Frankly," confided the good woman, "It's because the electricity keeps going off. Gas is much more dependable."

This wrenched our souls somewhat. We happen to know the utility in the area has a fine record of service continuity, and this particular residential area is quite free from such difficulties.

We suspect the concierge simply said the first thing that popped into her mind. But that this should be the first thing to occur to her is very disturbing.

This points directly to the old PR problem of good customer understanding. We've thought for a long time the utilities should blow their own horns, via radio, TV and printed page, to publicize the fine jobs they do on service continuity. Apparently there's at least a fringe of customers who still don't know the story.

Fischer Black

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One Of The Many Features Of The

RILEY TURBO FURNACE

Power Engineers of central stations and of large industrial power plants visiting a Riley Turbo Furnace installation burning coal are impressed at the remarkable cleanliness of the furnace . . . a major reason why more and more Turbo Furnace Boilers are being purchased. Ability of the Turbo Furnace to remain slag-free eliminates the need for slag blowing equipment and sustains an efficient furnace performance indefinitely.

Opposed firing into the Turbo Furnace hearth develops intimate mixing of fuel and air, rapid combustion at high temperature. Coals with widest range of ash fusion temperatures, ash and sulphur content, are suitable. Furnace walls stay clean because combustion gas rises vertically out of hearth in uniform stratum without turbulence and fills entire furnace cross section.

RILEY STOKER CORPORATION
WORCESTER, MASSACHUSETTS

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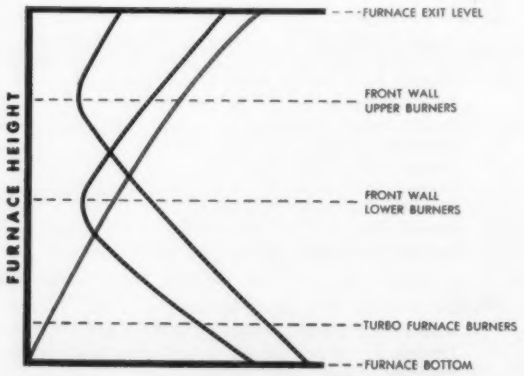
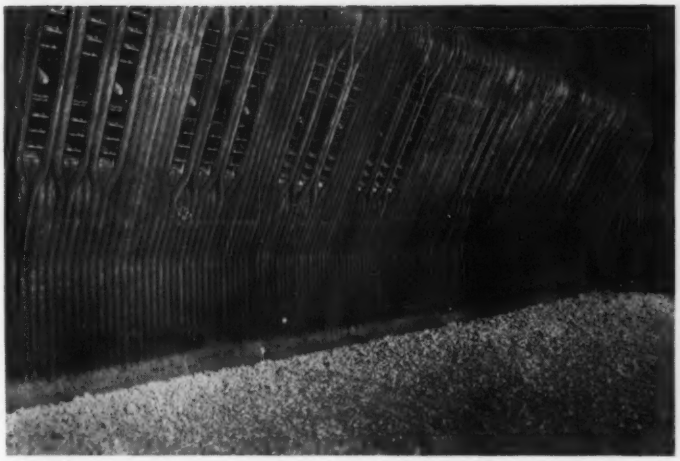
Charlotte, Chicago, Cincinnati, Cleveland, Detroit, Houston, Jacksonville, Kansas City, Los Angeles, New Orleans, New York, Philadelphia, Pittsburgh, Portland, Salt Lake City, San Francisco, Seattle, St. Louis, St. Paul, Syracuse, Worcester.



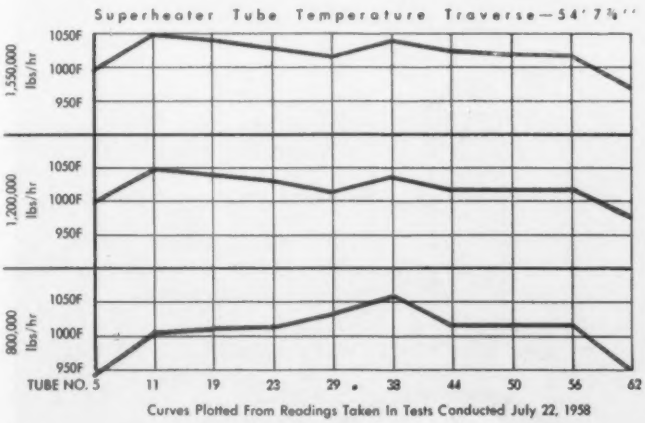
A comparison of temperature characteristics between wall firing and Turbo Furnace firing. Note with Turbo Furnace firing (red curve) highest temperature is at furnace bottom.



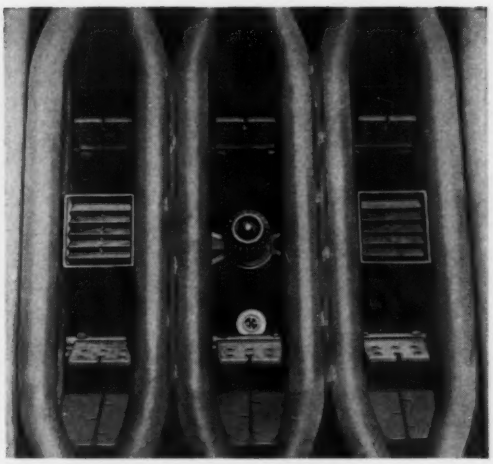
A few of 20 Burners in a 1,550,000 lb/hr Turbo Furnace Boiler. This is a 56 foot wide single furnace.

THERE ARE OTHER TURBO FURNACE ADVANTAGES, TOO!

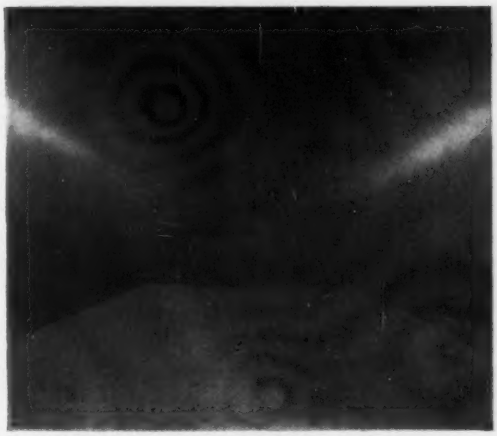
- **Tops For Multifuels** Combustion of coal, oil, gas, fluid coke, produces substantially equal furnace performance resulting in equivalent furnace exit temperatures, simplifying steam temperature control.
- **Eliminates The Flyash Disposal Problem** Reinjected flyash is removed as an easily handled, commercially useful, quenched slag; in some instances flyash from adjacent dry-bottom boiler can be disposed of in the Turbo Furnace.
- **Extra Wide, Undivided Furnaces Are Possible** The opposed method of Turbo Furnace firing removes limitations on furnace width inherent with other methods of firing.
- **Less Space Required** The permissable higher heat release of the Turbo Furnace results in smaller structures for a given capacity.
- **One Level Operation** All Turbo Furnace burners are at one operating level — usually common with the turbine operating level.
- **Minimum Superheater Metal Temperature Variations** Linear flame from side wall to side wall produces uniform heat release throughout the entire furnace width. Furnace gases rise evenly and vertically within the furnace, resulting in a flat gradient of the skin metal temperatures of superheater and reheater tubes.



Curves Plotted From Readings Taken In Tests Conducted July 22, 1958



The Riley Directional Flame Turbo Furnace Burner is a shop assembled unit which can be equipped complete with coal, gas, oil burners and automatic gas ignitors. Adjustable vanes direct air to control flame placement. No refractory is needed.



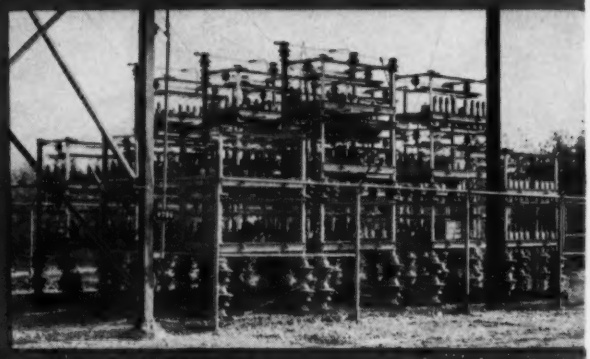
A highly turbulent linear flame with long residence time of combustibles results from downward opposed firing. Carbon loss is negligible.

The cooled slag pool of a shut-down unit returns to molten stage when unit returns to line. Note slag discharge opening and flyash reinjection ports.

A survey of your plant by a qualified consulting engineer could show ways of making surprising savings in your power costs.

RILEY

STEAM GENERATING & FUEL BURNING EQUIPMENT



Thirty 375 KVAR "Varblock" assemblies, each containing fifteen 25 KVAR, single-phase, 7620-volt TEMPALL power capacitors. These assemblies are part of a 11,250 KVAR, 3-phase, 69 KV capacitor installation.

creative engineering in action

TOBE DOESN'T JUST MAKE CAPACITORS... Tobe *creates* capacitors—to solve specific problems. And Tobe solutions are often outstanding examples of capacitor engineering through which the entire industry benefits.

Consider, for example, the problem engineers faced in the building of a substation which is practically in the Atlantic Ocean. Capacitors at this installation are subject to the corrosive attacks of salt water, sun and sand. But Tobe capacitors, with such features as stainless steel cases, self-locking neoprene terminal caps, and vibration-proof, concave washers on line hardware, stand up to the elements. They take abuse and keep on working because they are *created* to last.

This "creative engineering in action" is yours to call upon, whether you need capacitors for power-factor correction or for the generation of a shock wave in a "hot-shot" wind tunnel. Talk to Tobe today. TOBE DEUTSCHMANN CORPORATION, Norwood, Massachusetts.

TOBE 25 KVAR POWER CAPACITOR

TOBE

TEMPALL CAPACITORS

Since 1918, pioneers' research, foundation engineering.

News about

B.F.Goodrich Chemical *raw materials*

Sanford station of Florida Power & Light Company uses Geon conduit furnished by Hughes Supply of Daytona Beach. B.F.Goodrich Chemical Company supplies the Geon polyvinyl material only.

corrosion problem knocked out . . .

generating station gets conduit of Geon

YEARS from now pulling new cable through this conduit made from Geon polyvinyl materials will be just as easy as it is today. Unlike ordinary steel conduit, Geon conduit resists the corrosive effect of salt water, gases, chemicals and acid or alkaline soils. Internal and external surfaces stay smooth—like new.

Conduit or pipe made from Geon offers high tensile or impact strength. It stands up under pressure . . . is not subject to galvanic corrosion. It resists sunlight, fungi, bacteria, moisture, heat and cold. And its light weight makes installation especially easy.

Engineers are taking advantage of properties of pipe and conduit of Geon in a wide variety of applications. For information, write Dept. AT-5, B.F.Goodrich Chemical Company, 3135 Euclid Ave., Cleveland 15, Ohio. Cable address: Goodchemco. In Canada: Kitchener, Ont.

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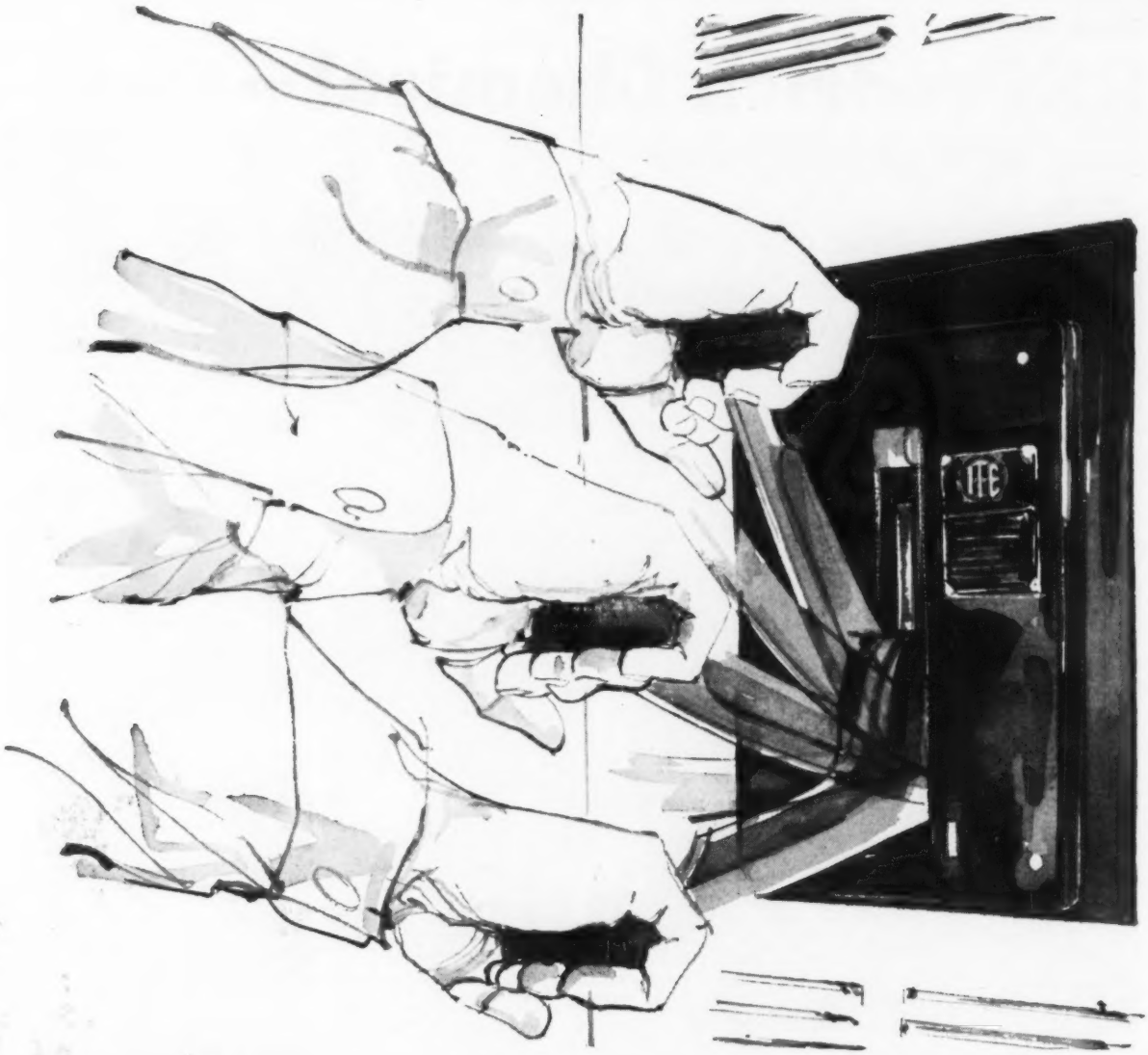


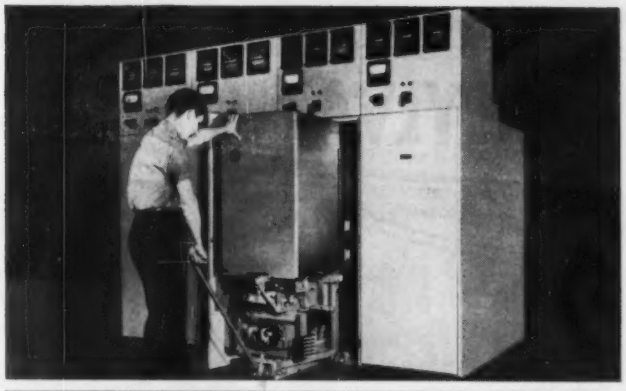
COMPARE

It's easy to see how far I-T-E equipment is ahead of other makes. Just make a point-by-point comparison. Take the new K-LINE circuit breakers for low-voltage switchgear, for example.

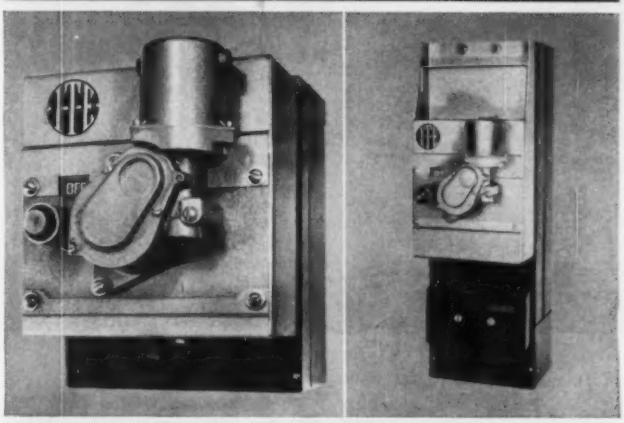
Note the new pulldown handle and stored energy mechanism that give you quick-made closure for longer contact life and greater operator safety. With the front door closed, you can draw the breaker all the way out to disconnect position. And the new expanded range trip adjustment lets every breaker handle a wider range of loads without modification.

In ratings up to 600 amp, these compact circuit breakers stack four high in standard I-T-E enclosures. For added flexibility, you can shift the low rating breakers to the larger enclosures when convenience dictates.

How much more do you pay for all these extra features? Nothing! It's an I-T-E policy. More value for your money.

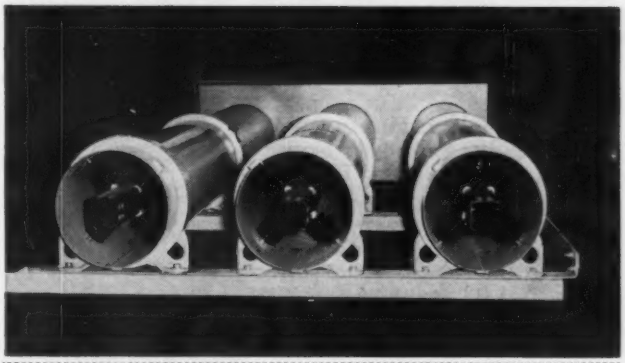


Metal-clad switchgear you can be proud of. Extra sturdiness for longer life. Extra craftsmanship for finer appearance. Extra safety for greater personnel protection. All components are completely accessible. Even rear doors are hinged. Advanced design, uniform-flux-density coils mean extra protection against heavy fault current. A complete line of circuit breakers in both 4.16 and 13.8 kv ratings.



Push a button . . . operate the CORDON.® Here's molded case economy with remote control luxury. New I-T-E CORDON circuit breakers are available with new TELEMAND* motor-operators for remote opening, closing or resetting. CORDON circuit breakers provide up to 100,000 amp interrupting capacity in roughly half the switchboard space required by alternative devices. They cost approximately ⅓ less. TELEMAND operation is available on the complete range of molded case and CORDON circuit breakers from 70 through 800 amp.

**Trademark, I-T-E Circuit Breaker Co.*



Safer, more compact main bus. Not a single case of phase-to-phase short circuit has ever been reported on I-T-E Isolated Phase Bus since I-T-E introduced it 22 years ago. Such performance is proof of good design and consistently high-quality construction. I-T-E uses cylindrical enclosures for superior heat dissipation, easier gasketing, lower cover losses, better shape retention with internal pressure, and saving in weight. Sliding covers permit easy inspection. Full line of auxiliary equipment available. Ratings from 4.16 to 34.5 kv and through 20,000 amp.

SEND COUPON

Get complete, up-to-date information on I-T-E equipment.

I-T-E Circuit Breaker Company U-4

1900 Hamilton St., Philadelphia 30, Pa.

- ☐ K-LINE LV switchgear (600 v)
- ☐ Metal-clad switchgear (4.16 and 13.8 kv)
- ☐ Motor-operated molded case circuit breakers
- ☐ Primary unit substations
- ☐ Outdoor substation structures
- ☐ Isolated phase bus
- ☐ Reclosers
- ☐ Distribution cutouts
- ☐ Other_____

Name_____ Title_____

Company_____

Street_____

City_____ Zone_____ State_____

I-T-E CIRCUIT BREAKER COMPANY

PENNSYLVANIA TRANSFORMER introduces .....

1st ■ ■ ■ LTC transformer to permit safe inspection and maintenance of LTC switch contacts and complete drive mechanism while transformer remains energized and supplies uninterrupted three-phase power to its load.

1st ■ ■ ■ three-phase LTC transformer to provide *SINGLE PHASE* regulation controlled individually from separate independent control circuits.

In announcing the new Phase-Isolated LTC Transformer, the sales and design engineers believe they are offering the ultimate in three-phase transformers. For the first time, here is a transformer that offers you *ALL* of the advantages and flexibilities of single-phase regulation. The cost is only slightly higher than that of a conventional three-phase LTC transformer; however, this extra cost is more than erased by the economies derived in the following two ways:

(1) Purchasing and handling a single piece of equipment.

(2) Installing and placing into service one Phase-Isolated LTC three-phase transformer rather than three separate regulators, bypass switches and a transformer or a transformer bank.

THREE INDEPENDENT CONTROL CIRCUITS

Each phase of Pennsylvania's three-phase LTC transformer has an independent control circuit and LTC mechanism. This enables it to regulate the outgoing voltage of each phase in accordance with the individual load demands of each phase. The separate control circuit for each phase allows the accurate selection of "R" and "X" compensation settings for each phase. Similarly, each phase has its own independent voltage regulating relay, voltage level adjustment, band width adjustment, operation selector switch, operation counter, integrating time delay assembly, and potential test terminals.

COMPLETELY SELF-CONTAINED

All Pennsylvania Phase-Isolated LTC Transformers are completely self-contained. Each phase has a separate internally mounted current transformer for its independent line drop compensator and a separate internally mounted potential supply for its independent voltage regulating relay and LTC mechanism drive motor.

BYPASS SWITCH

Each phase of Pennsylvania's Phase-Isolated LTC Transformers has a manually operated, integrally mounted, oil-immersed combination LTC bypass, disconnecting, and grounding switch that permits safe inspection and maintenance of LTC switch contacts and complete drive mechanism while the transformer remains energized supplying uninterrupted three-phase power. The bypass switch for each phase is key interlocked to prevent operation except when the LTC mechanism for that phase is in its neutral position. Terminals are provided for the convenient attachment of visible grounds to both ends of the series winding and both ends of the preventive auto winding when the LTC compartment is open.

For further information write on your company letterhead for free copy of descriptive booklet No. 591. Address Sales Dept. Pennsylvania Transformer Division, McGraw-Edison Company, Canonsburg, Pa.

Pennsylvania Phase-Isolated Three-Phase Transformers are available in the following kva and voltage ratings:

BIL	LOW VOLTAGE	KVA
75 Kv	4160Y/2400 or 4360Y/2520 volts	1000 Kva thru 2500/3125 Kva incl.
95 Kv	8320Y/4800 or 8720Y/5040 volts	1000 Kva thru 5000/6250 Kva incl.
110 Kv	12470Y/7200 or 13090Y/7560 or 13200Y/7620 or 13800Y/7900 volts	1000 Kva thru 7500/9375 Kva incl.

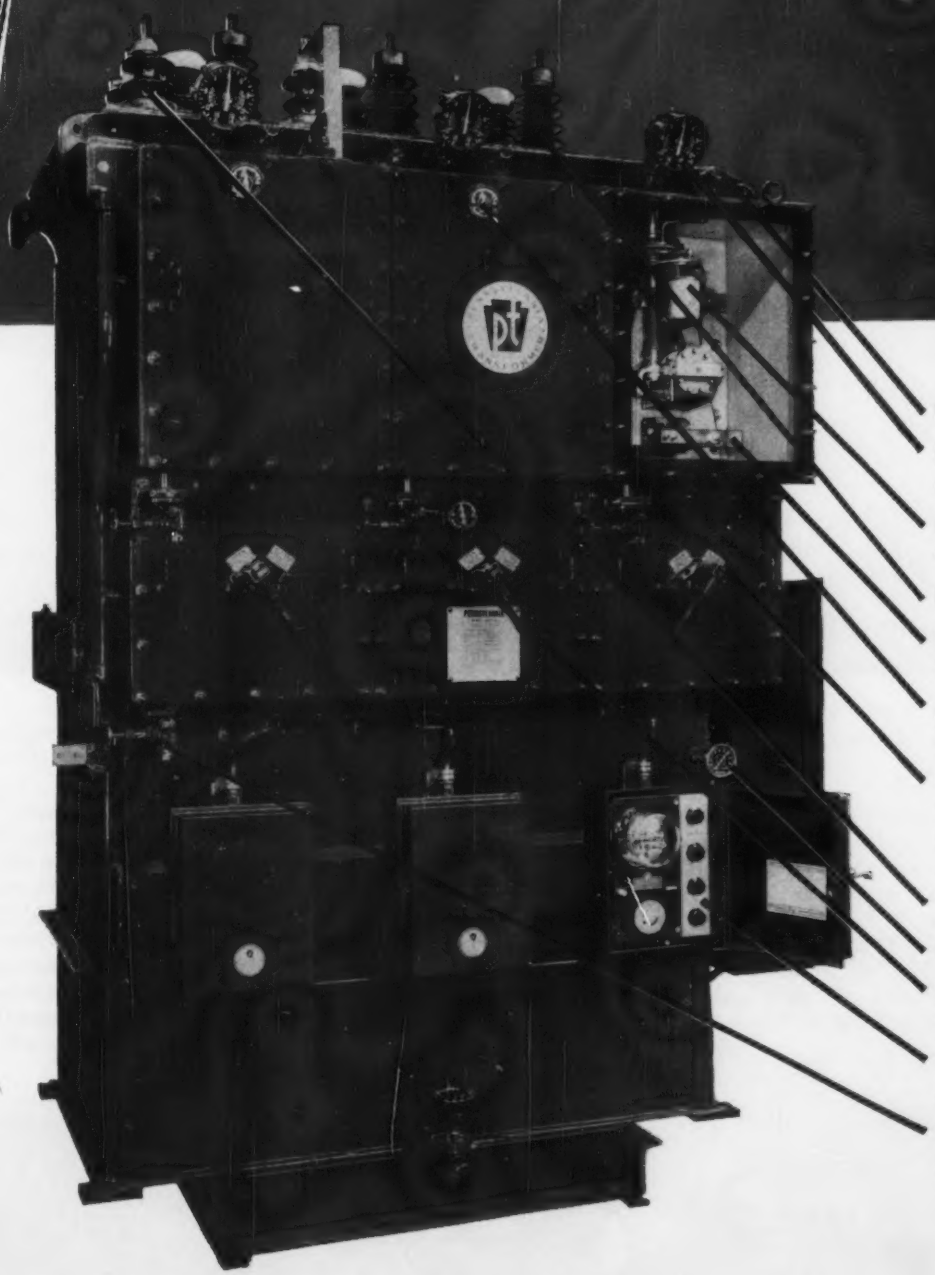
PENNSYLVANIA TRANSFORMER DIVISION
McGRAW-EDISON COMPANY
CANONSBURG, PA. *Greater Pittsburgh District*

McGRAW EDISON

P E N N S Y L V A N I A

the NEW Phase-Isolated LTC TRANSFORMER

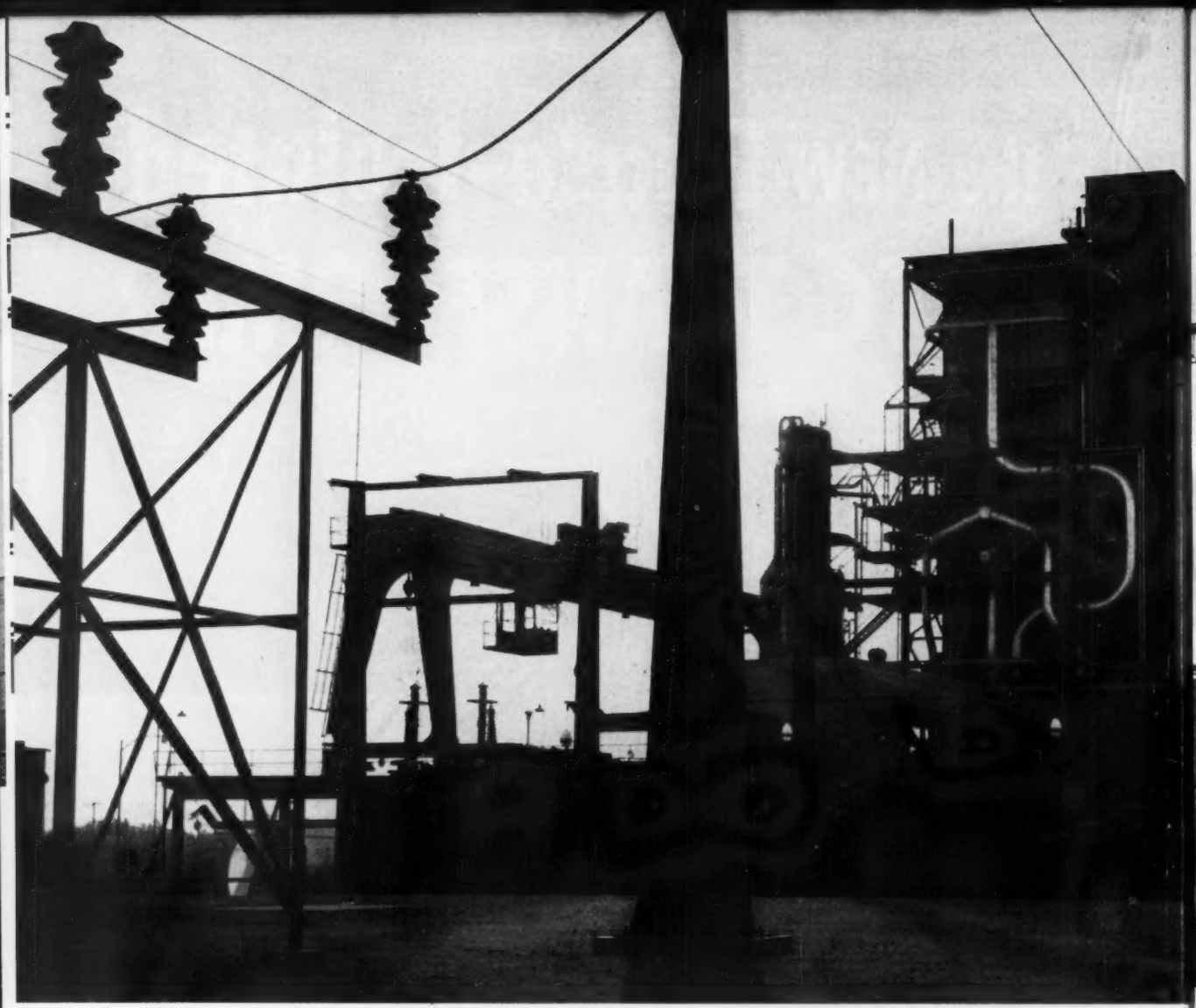
(Patent Applied For)



- Key interlock.
- Position indicator with adjustable limit switches.
- Individual LTC mechanism and drive motor.
- High voltage bushings.
- Provisions for conveniently applying visible grounds.
- Magnetic type liquid level indicator.
- Key interlocked, manually operated, combination LTC bypass, disconnecting and grounding switch.
- Low voltage bushings.
- Pressure vacuum gauge.
- Individual LTC compartment drain valves.
- Weatherproof control cabinet.
- Bypass switch compartment drain valve.

POWER TRANSFORMERS

PENNSYLVANIA TRANSFORMER

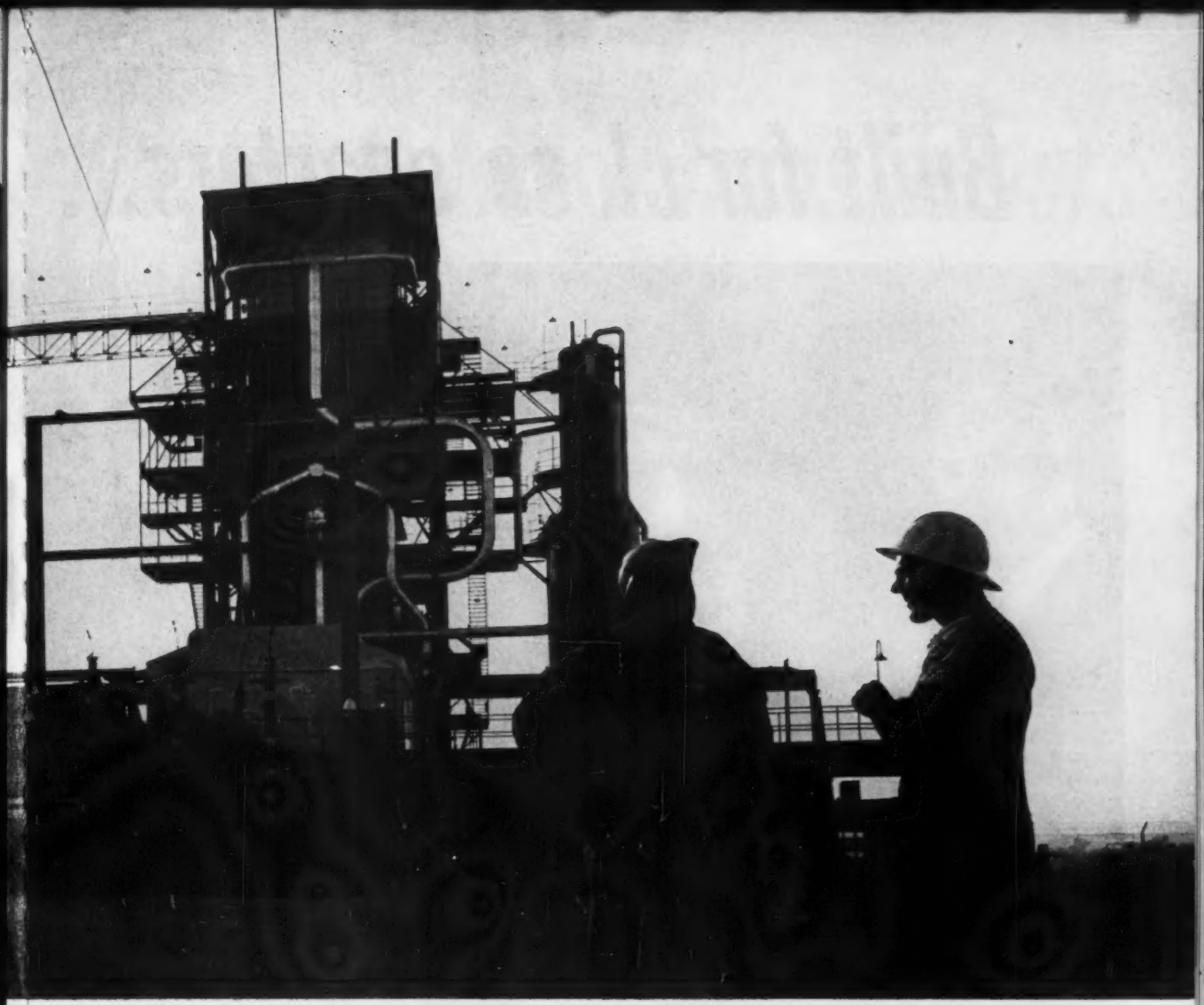


New Plant at San Bernardino

The two-unit, 132-m.w. steam plant recently completed at San Bernardino for California Electric Power Company has a number of unusual features.

There are only two operating levels—grade and firing aisle. A broad ramp permits access to the firing aisle by large trucks, and on both levels clearances are ample so that equipment can be serviced by fork-lifts. All rotating equipment, except turbo-generators, is mounted at ground level, minimizing vibration and simplifying maintenance.

All feedwater heaters, together with many pumps and other auxiliary items, are located in a bay between the two turbo-generators, where they are easily accessible to the gantry crane and to fork-lift maintenance trucks.



The plant burns natural gas or heavy residual fuel oil. A unique oil pumping system eliminates the need for heated lines from storage to day tank.

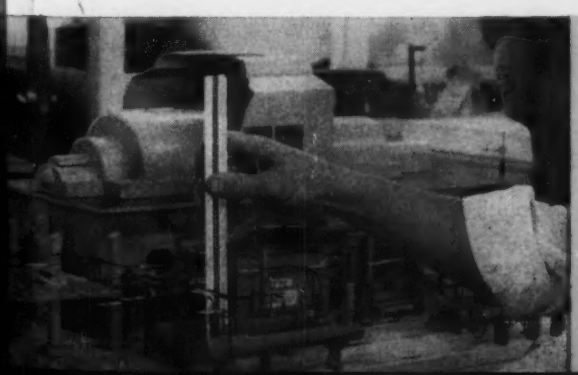
All principal water tanks are combined into two 82-foot "pisa towers" which support the deaerators, and all sweet-water condensates drain into two collecting wells sunk 42 feet below ground level.

The plant is operated by three men per shift. Both units were completed ahead of schedule and below the cost estimate, and both were placed in commercial operation within two weeks after first roll-over.

Structural layout and all important details were worked out on a scale model before any drafting was done. Calectric engineers were able to watch their plant grow in three dimensions, approving each detail as it was added to the model.

The plant was built by Fluor under a total-responsibility contract covering economic study, design, engineering and construction. This arrangement enabled Calectric to exercise complete day-to-day control over the entire course of the project, in close liaison with Fluor project management.

The Fluor brochure, "Calectric's San Bernardino Steam Plant," describes this unusual station in detail. Write to Department #92, The Fluor Corporation, Ltd., 2500 South Atlantic Boulevard, Los Angeles 22, California.



When you consider expansion...

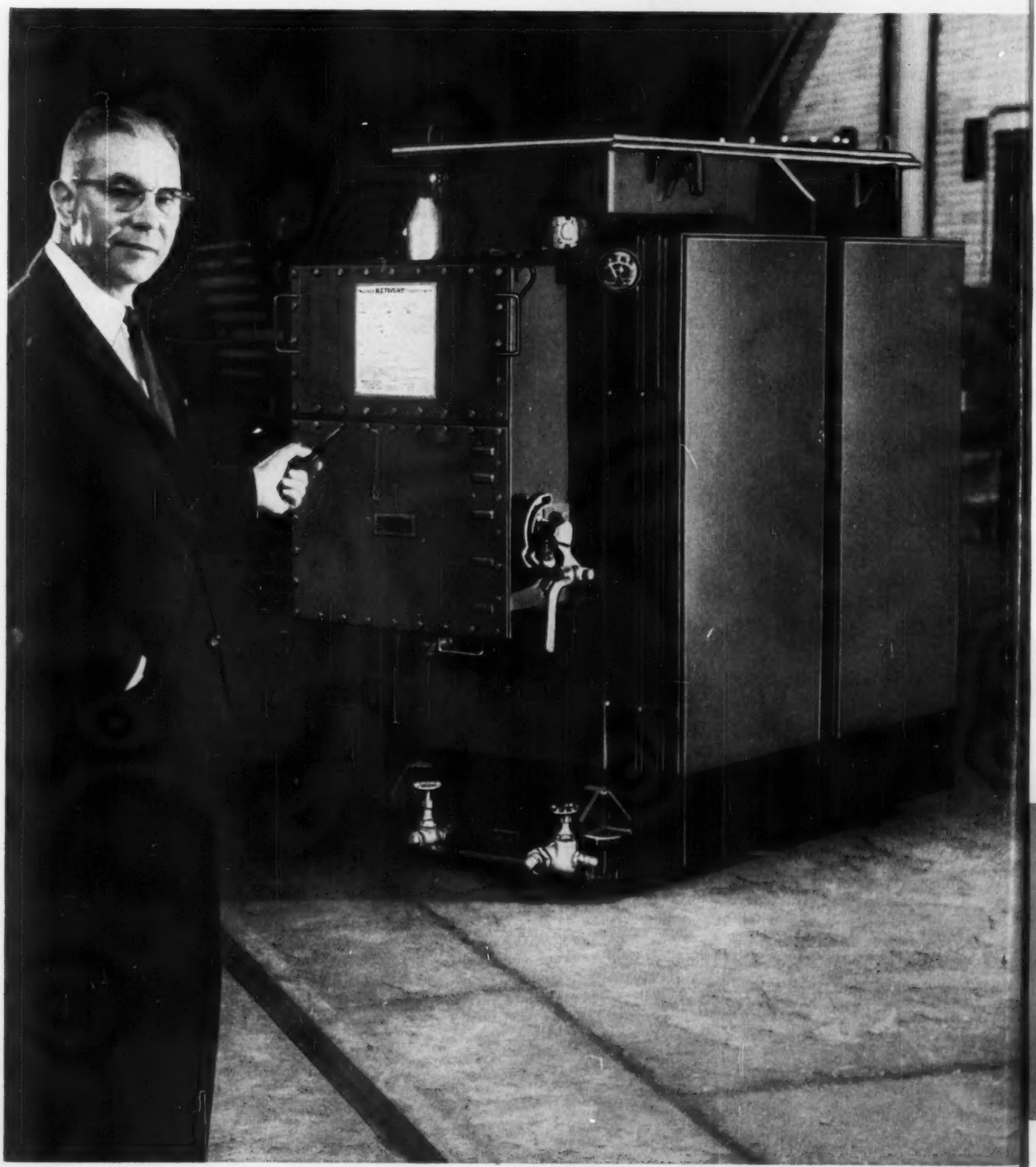
the most important investment you can make

is in the creative ability of men

FLUOR

Engineers & Constructors

Built for close quarters...



Wagner Network Transformers

are small in size... have compact switch... feature panel radiators for smoother contour

Wagner network transformers are designed to give you smaller, lighter units, with smoother contours for easier maintenance. You can cut network system costs by using smaller vaults with these space-saving transformers—or you can put larger ratings in your present vaults. You save on maintenance, too. The panel type radiators are easy to clean, and an anti-corrosive tank finish protects exterior surfaces for years, under the adverse conditions of underground installation.

NEW WAGNER-DEVELOPED ROTARY SWITCH ... The rotary type, liquid filled high voltage switch was designed especially to meet the requirements of network systems—it is smaller in depth than previously used knife-blade type switches.

LOWER NOISE LEVEL ... Improvements in core design and materials, and newly developed methods of treating the core steel have made lower noise levels a feature of all Wagner transformers.

Constant research and development have kept Wagner up front in transformer design for more than 65 years—made the name Wagner one of the foremost in power planning.

For expert advice in solving your network transformer problems, consult your nearby Wagner Sales Engineer. There are Wagner Branches in 32 principal cities.

BRANCHES AND DISTRIBUTORS IN ALL PRINCIPAL CITIES

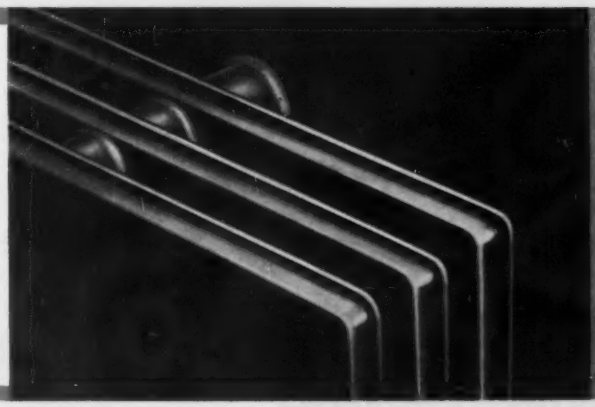
Wagner Electric Corporation

6456 PLYMOUTH AVENUE, ST. LOUIS 14, MISSOURI

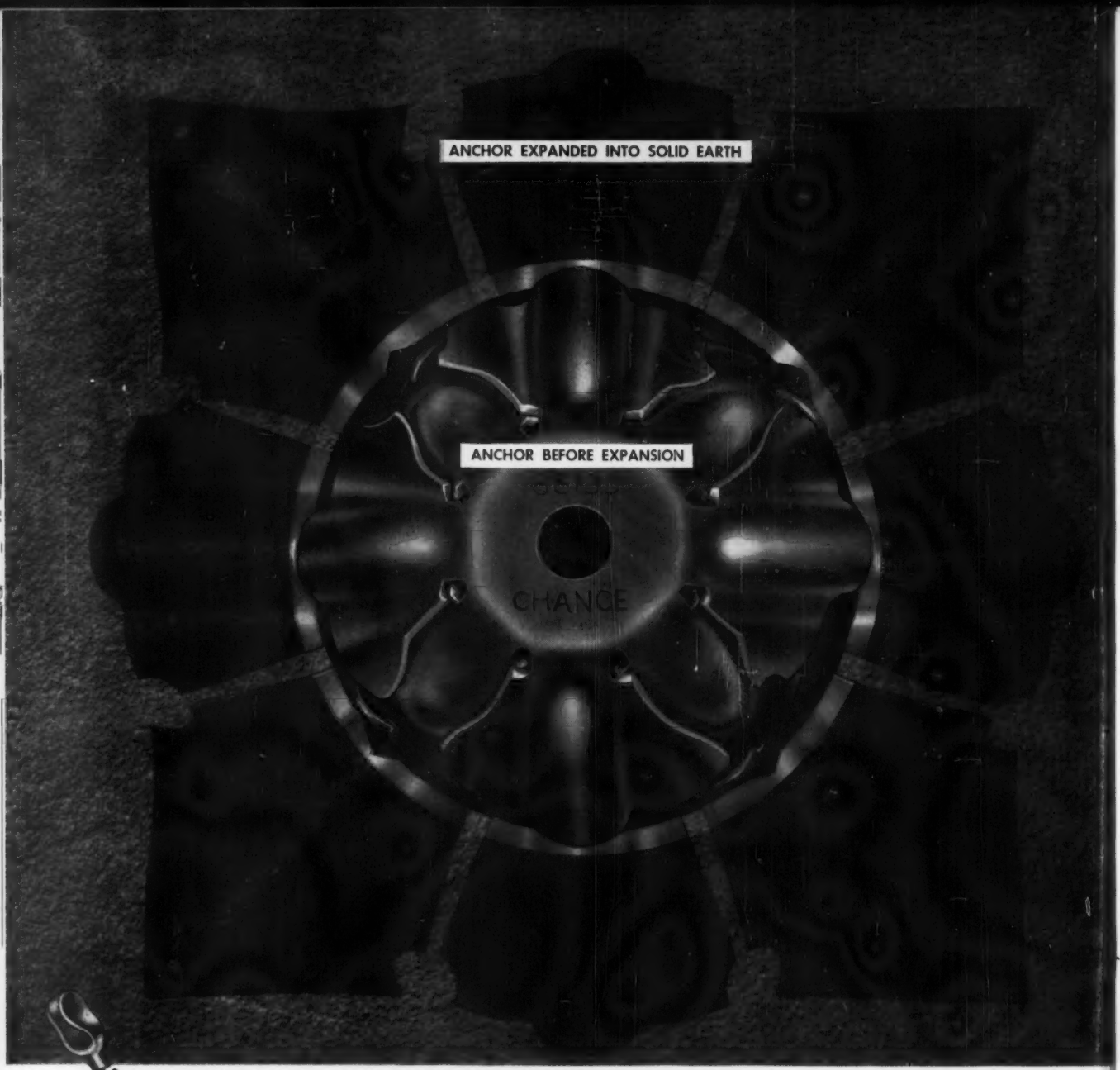
WT59-7

NEW PANEL-TYPE RADIATORS

New design radiators have smooth vertical surfaces with far fewer places where corrosive moisture and dirt can accumulate. They're easy to keep clean. Reliability is improved because there are fewer places for leaks to develop.



SERVING 2 GREAT GROWTH INDUSTRIES... *ELECTRICAL... AUTOMOTIVE*



You get over 60% expansion into solid earth with this CHANCE 8-Way Expanding Anchor

It's a fact! Sixty three per cent of the Chance 88135 Anchor, shown above in reduced size, expands into solid, undisturbed earth. All Chance 8-Ways give similar expansion—develop all-around holding power. The eight rib-reinforced blades expand to form a square, with no wasted space between blades. Holding power is distributed over a wide area.

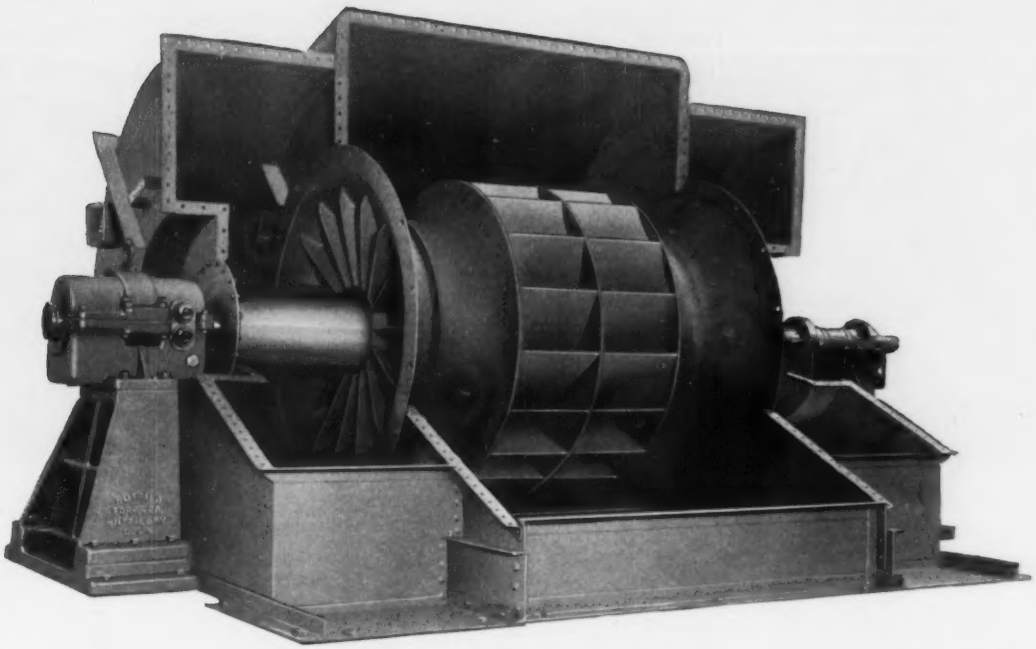
Chance 8-Ways are now packed in extra high-strength, color-coded cartons for better storage and handling.

Build lines to STAY with the CHANCE 8-WAY

A. B. CHANCE COMPANY

CENTRALIA, MISSOURI A. B. Chance Co. of Canada, Ltd., Toronto

CA59-5



"Buffalo" Airfoils are Available in Capacities in Excess of One-Half Million CFM, Pressures to 80" Water.

"BUFFALO" AIRFOILS COST LESS TO OPERATE ...REQUIRE LESS MAINTENANCE

HERE'S WHY: If you are considering the use of airfoil fans for mechanical draft service, ponder these facts regarding the "Buffalo" Airfoil.

With a true peak mechanical efficiency up to 92% and an extremely broad static efficiency curve, as compared to most competitive airfoil designs, the "Buffalo" Airfoil definitely costs less to operate. Major factors governing this efficiency are—a completely streamlined inlet with inlet bell and wheel flange forming a true half-circle—fixed or variable inlet vanes, where used, are placed well into the inlet throat to fully utilize horsepower reducing spin developed by the vanes—generous inlet boxes with external bracing give low entry loss—airfoil wheel incorporates proper blade passages for best air-flow through the wheel—scroll shape lets air stream from blade passages to housing channel with greatest ease—divergent outlet provides optimum static regain from cut-off.

This top efficiency, combined with the famous "Buffalo" "Q" Factor* Construction for a longer life with less maintenance, makes the "Buffalo" Airfoil best suited for this specialized service. For full details phone your Buffalo Engineering representative or write for Bulletin FD-905.

**The "Q" Factor — the built-in Quality which provides trouble-free satisfaction and long life.*

"Buffalo"

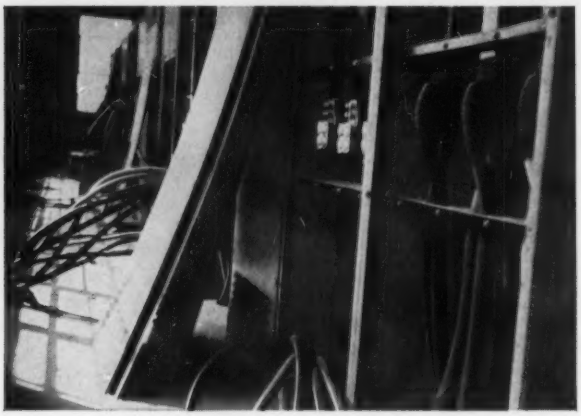
BUFFALO FORGE COMPANY
Buffalo, N. Y.

Buffalo Pumps Division Buffalo, N. Y.
Canadian Blower & Forge Co., Ltd., Kitchener, Ont.

VENTILATING • AIR CLEANING • AIR TEMPERING • INDUCED DRAFT • EXHAUSTING • FORCED DRAFT • COOLING • HEATING • PRESSURE BLOWING

Installed in underground ducts, Paranite Super Pararite-Paraprene® network cable services a modern electronic computor installation.

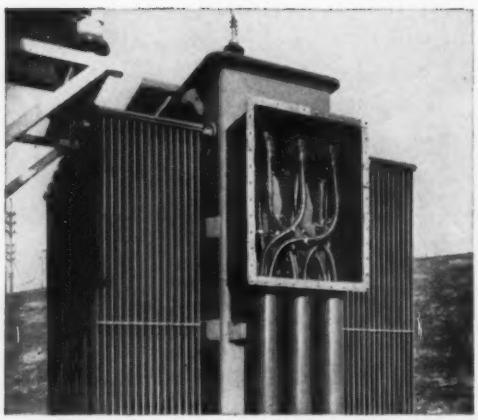
Paranite Super Pararite-Parasyn cables carry primary power between transformers and switchgear control panels in an ore reduction plant.



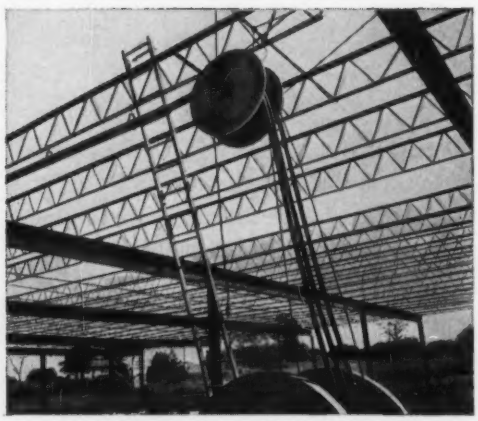
Across the nation for trouble-free installations...

PARANITE®

"IF IT'S PARANITE IT'S RIGHT"®



Paranite Super Pararite-Paraprene cable serves as the primary transformer feeder in a new municipal water pumping station.



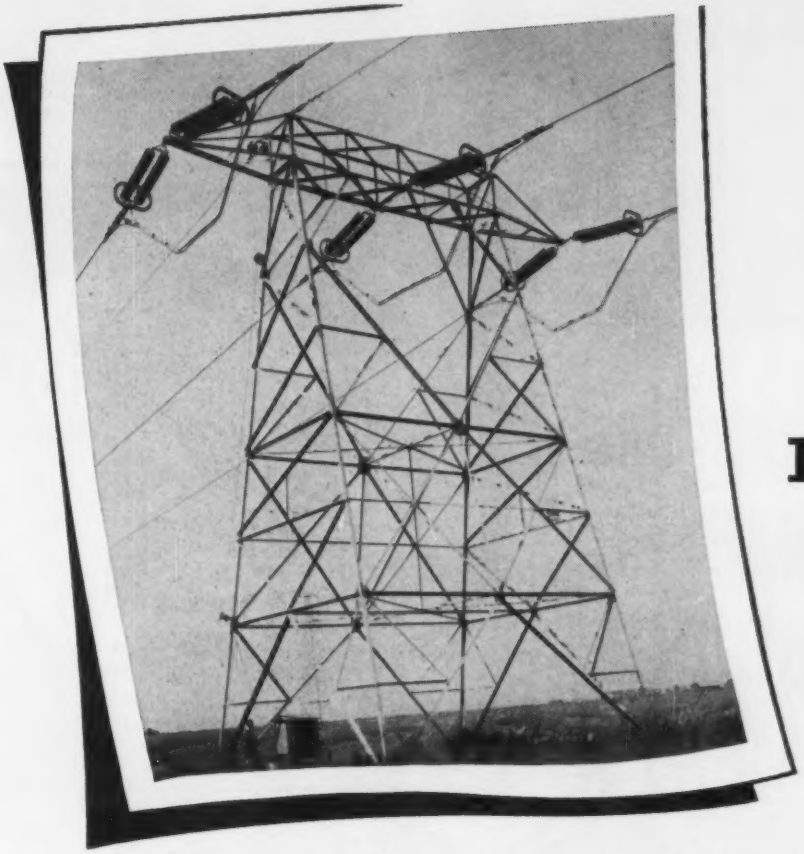
Overhead duct installation of Paranite Super Pararite-Parasyn® (PVC) serves as a secondary feeder cable in a manufacturing plant.

The consistent selection and performance of Paranite cables from 600 volt network through 23,000 volt power cables mark them as products of close quality control. These Super Pararite-Paraprene and Super Pararite-Parasyn (PVC) cables illustrated above, indicate the versatility, national availability and proven trouble-free performance of Paranite installations.

PARANITE WIRE AND CABLE DIVISION

Essex Wire Corporation, Fort Wayne, Indiana

MANUFACTURING PLANTS: Marion, Ind.; Jonesboro, Ind.; Tiffin, Ohio; Birmingham, Ala.; Anaheim, Calif. • Sales Offices in All Principal Cities



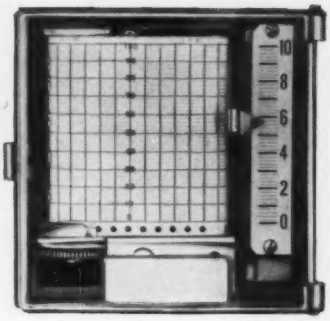
In 1923 this was EHV

Lapp "high strength" suspension insulators were used by Southern California Edison Co. for its 220 kv Eagle Bell line. Erected in 1923, this line is now in its 35th year of service. Original insulators are still in place. Company reports "no trouble"; total replacement of insulators for all causes over 34 years is "less than 1%."

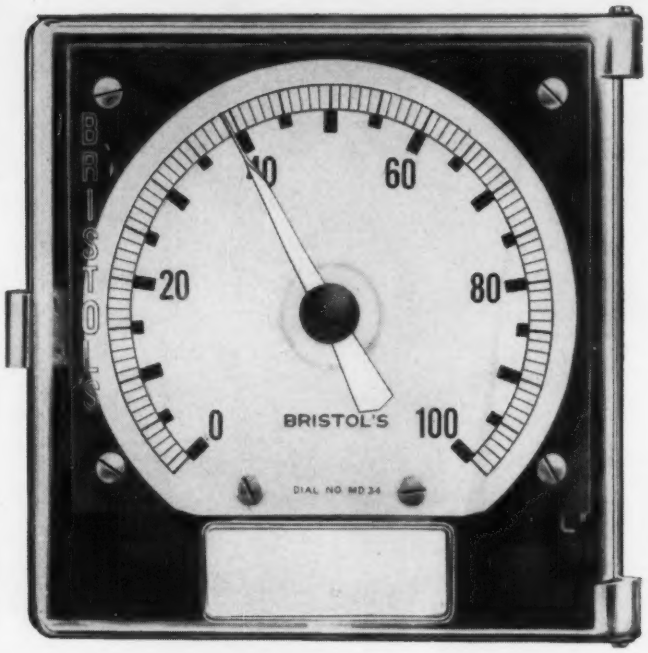
"Design for electrical security and long life—then do all you can to make it strong." This has been a Lapp principle from the beginning. In 1923, when the line shown above was erected, the insulators on it were cataloged as 18,000-lb. units—at a time when the industry was talking generally of 9,000-lb. and 12,000-lb. units. Before, and since then, Lapp has pioneered in insulators that combine long life with high mechanical strength.

For your EHV and other high-mechanical-loading requirements, specify the current Lapp 25,000-lb. suspension units; another generation of operating people in your company will be proud of the service records they set.

Lapp Insulator Co., Inc., Le Roy, N. Y.

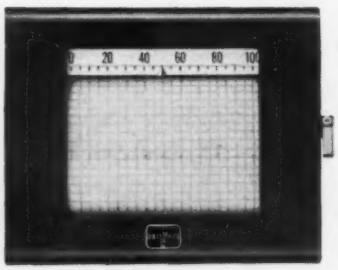


BRISTOL Indicating Electronic Dynamaster* Potentiometer and Bridge (shown below) has 8" effective scale length. Recording Electronic Dynamaster (left) has 3" chart. Panel sizes: Only 5" x 5⅛".



miniature electronic POTENTIOMETER and BRIDGE INSTRUMENTS

for nuclear power and test reactors



Large-scale Dynamaster—11" chart.

The now-famous Shippingport, Pa., Atomic Power Station... The Bristol Company is one of the instrument suppliers.

More and more reactors are going on the line under Bristol measurement and control, and they're specified for many more under construction.

Miniature Bristol Electronic Dynamaster* Indicators and Recorders, furnished as either potentiometers or bridges, can measure any variable that can be transduced to an electrical quantity... **pressure, flow, temperature, liquid level, pH, and conductivity.** Already, in the nuclear industry as in hundreds of others, these high-precision miniature instruments are establishing an outstanding record for reliability, consistent performance, and utmost flexibility. Here are just a few reasons why:

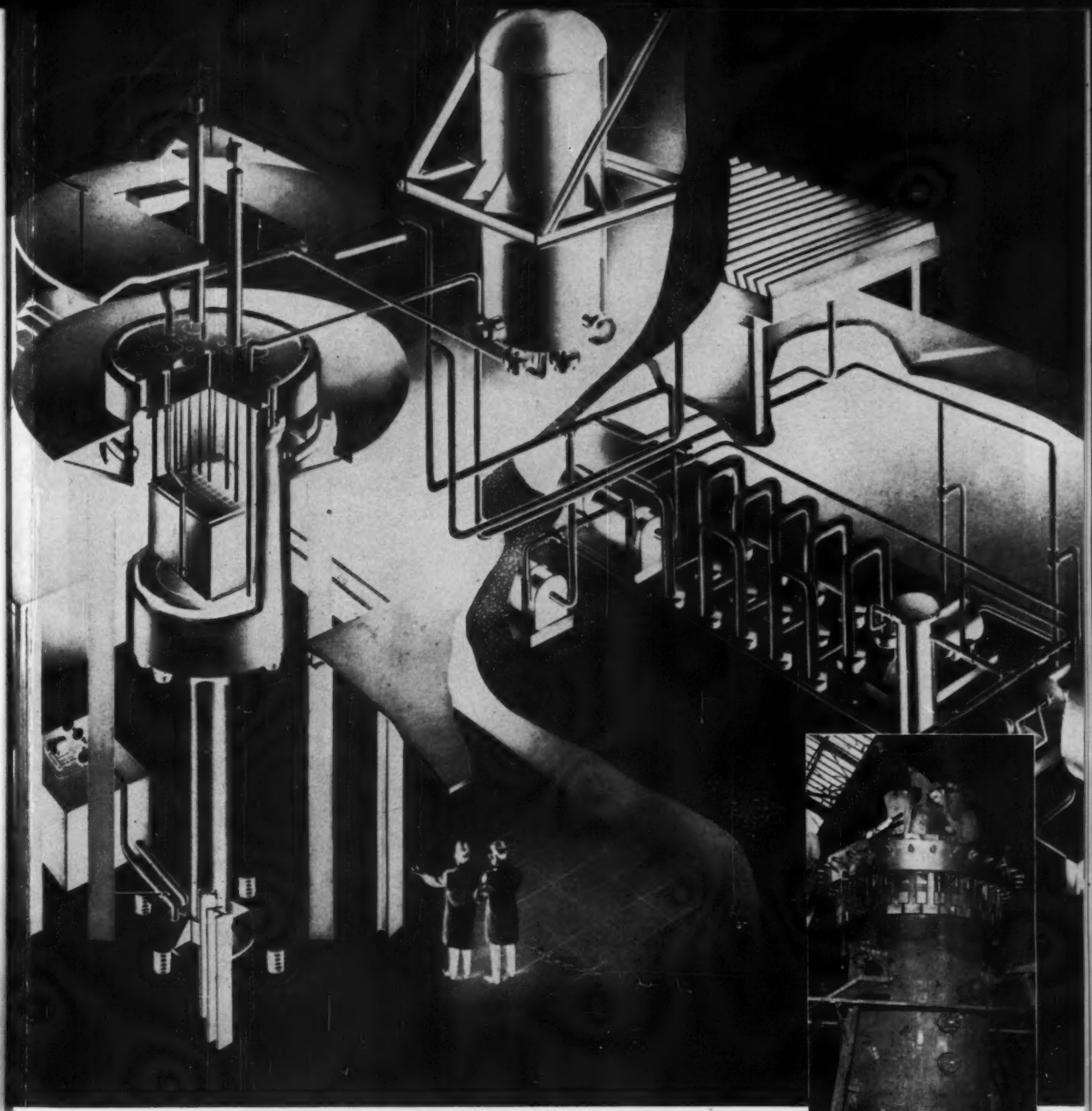
FULL PLUG-IN FLEXIBILITY. You can interchange chassis in ten seconds... replace it with either recorder or indicator instruments... both plug in easily without tools. Chassis also pulls out to intermediate position for chart changing and inking without disconnecting from circuit. Easy range change, too.

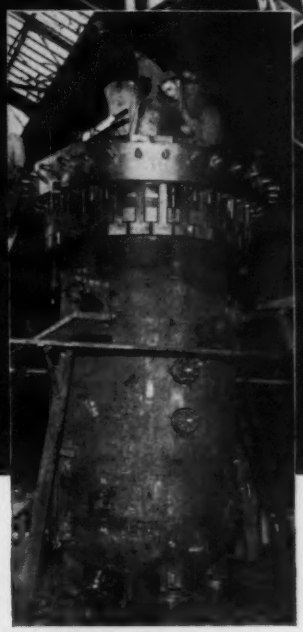
These features simplify planning of graphic control panels. Fifteen miniatures mount in less space than two full-sized units. The Bristol Company, 116 Bristol Road, Waterbury 20, Connecticut. 9.5

*T.M. Reg. U. S. Pat. Off.

BRISTOL TRAIL-BLAZERS IN PROCESS AUTOMATION

AUTOMATIC CONTROLLING, RECORDING AND TELEMETERING INSTRUMENTS





The Proof Test Reactor Pressure Vessel, with quick-opening closure, in Kellogg's Jersey City plant just prior to shipment.

FIRST EVER BUILT

—this high-temperature nuclear test reactor was developed by Knolls Atomic Power Laboratory to confirm design data for reactor cores of the submarine Triton. Vital core components and instrumentation are housed in a 32½-ton stainless steel pressure vessel. Required to withstand 550 F., 1,500 psi, this vessel and its novel, quick-opening closure were designed and fabricated for KAPL by The M. W. Kellogg Company.

Additional examples of Kellogg's ability to design and fabricate nuclear equipment to the most exacting standards include the primary coolant stainless piping for two other nuclear plants. Kellogg is also designing and fabricating heat exchangers for still another nuclear plant. Kellogg's Fabricated Products Sales Division welcomes inquiries for the design and fabrication of nuclear equipment.

THE M. W. KELLOGG COMPANY, 711 THIRD AVENUE, NEW YORK 17, N. Y.

A SUBSIDIARY OF PULLMAN INCORPORATED

The Canadian Kellogg Company Limited, Toronto • Kellogg International Corp., London • Kellogg Pan American Corp., Buenos Aires Societe Kellogg, Paris • Companhia Kellogg Brasileira, Rio de Janeiro • Compania Kellogg de Venezuela, Caracas

M KELLOGG W

PP-35

Pittsburgh Piping

HAS BEEN VITAL TO NUCLEAR POWER

When the submarine Nautilus nosed down the ways the age of peacetime atomic power began. Next came the opening of the Duquesne Light Company's Shippingport Station—America's first atomic power plant. Pittsburgh Piping fabricated nuclear power piping for both installations.

We have since been chosen to produce essential piping components for the nation's growing fleet of atomic powered submarines and surface vessels, and for a wide variety of industrial and government nucleonic installations. For all of these jobs, the piping must be *right*, from the beginning—which is the key reason why Pittsburgh Piping has been preferred, right from the beginning.

Pittsburgh Piping **AND EQUIPMENT COMPANY**
158 49th STREET • PITTSBURGH 1, PA.

PIONEER FABRICATOR OF HIGH PRESSURE PIPING FOR NUCLEONICS

AT HOME OR ABROAD...

call on Ebasco for nuclear engineering services

Ebasco teamwork gets things done anywhere in the world.

Among Ebasco's growing activities in the nuclear field are these major projects:

IN AMERICA, for the U. S. Atomic Energy Commission, a conceptual design of a 306,000-kw boiling water nuclear power plant; for the AEC's Knolls Atomic Power Laboratory, engineering, design, inspection of construction, and preparation of operating manuals for the off-hull facilities for the prototype of the first nuclear powered destroyer; and for the Southwest Atomic Energy Associates, consulting nuclear engineering for the development of an advanced thorium reactor system.

OVERSEAS, for SENN in Italy, engineering and construction of a 150,000-kw nuclear power plant; and for the Japan Atomic Energy Research Institute, engineering, design and inspection of construction of a 12,500-kw nuclear power plant.

Wherever you may be planning to utilize atomic energy, Ebasco's nuclear experience can serve you well. Along with Ebasco's 54-year reputation for uncompromising quality in general engineering and construction, it can be your assurance of practical and economical results.

Ebasco performs the following nuclear engineering services for clients:

- ★ Reactor Systems Evaluations
- ★ Design of Nuclear Plants
- ★ Construction of Nuclear Plants
- ★ Hazards Analyses
- ★ Start-Up and Testing of Plants
- ★ Training of Operating Staff
- ★ Engineering and Economic Investigations
- ★ Research and Development Assistance
- ★ Nuclear Investment Consultation
- ★ Coordination with Government Agencies

For more information about Ebasco's nuclear engineering services, write Ebasco Services Incorporated, Dept. M. Two Rector Street, New York 6, N. Y.

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TRIPLE LANE TUBE LAYOUT . . .

what it is and how it IMPROVES CONDENSER OPERATING EFFICIENCY

An informative advertisement from one of the nation's most experienced condenser manufacturers

Steam condenser efficiency depends on water temperature and condition, proper maintenance procedures and many other factors. One of the most important is the design of the condenser itself—and *this* is largely a function of tube sheet design.

Triple Lane Tube Layout, a development of C.H. Wheeler Manufacturing Company of Philadelphia, is making significant contributions to condenser operating efficiencies in public utilities and industrial plants throughout the country. Figure 1 shows a C.H. Wheeler Dual Bank Surface Condenser with Triple Lane Tube Layout.

This tube sheet design permits steam to travel through three separate pathways. As a consequence steam penetrates to all condensing surfaces and utilizes to the fullest extent the condensing capabilities of the steam condenser.

Figure 1: Typical C.H. Wheeler Condenser with Triple Lane Tube Layout.

Central location of the air cooler section, another C.H. Wheeler design feature, also improves steam travel. It reduces the depth of steam penetration and therefore reduces resistance to steam passage, achieving a new low in condenser pressure loss.

How Reverse Flow Improves Condenser Efficiency, Reduces Maintenance

Proper maintenance—keeping tubes and tube sheets free from foreign matter, algae and scale—helps keep condensers operating at peak efficiency. In some cases grass and twigs build up to a point where they would ordinarily have to be shoveled out! It is in such cases that C.H. Wheeler Reverse Flow solves time-consuming, expensive maintenance problems. Here's how it works:

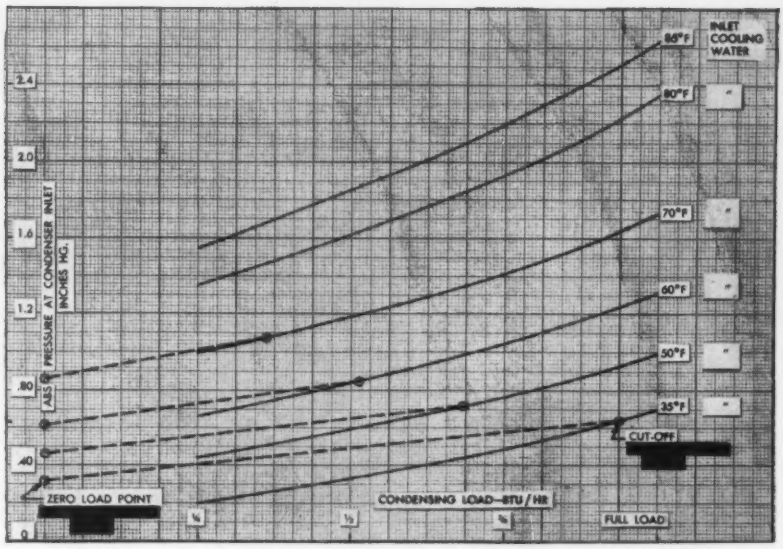


Figure 2: Typical condenser performance curves show how inlet cooling water temperature affects absolute pressure at condenser inlet at varying condensing loads. For a complimentary copy of the 38-page Condenser Handbook from which these curves are taken, write to C.H. Wheeler on your company letterhead.

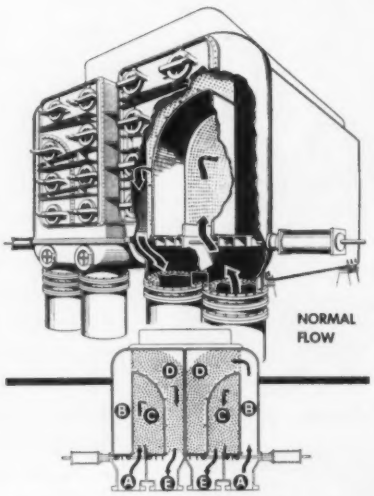


Figure 3: Diagram of C.H. Wheeler Reverse Flow which cleans tubes and sheets during full load operation.

Normal operation is shown on the left in the diagram in Figure 3. Water enters through inlet A with inside port open, flows through tube bank C to the rear of the condenser. It returns through tube bank D to the front of the condenser and discharges at E.

The right side of the diagram in Figure 3 shows Reverse Flow in operation in a C.H. Wheeler Dual Bank, Divided Water Box Condenser. Water enters through A with outside port open, flows up through channel B and through tube bank D to rear of condenser, returns through tube bank C to front of condenser and discharges at E.

Reversing can be accomplished during full load operation and full flow of circulating water, without additional pressure loss. Sluice gates for each half of the condenser move on a common stem. Each half of the condenser can be back-flushed independently; or both halves can be back-flushed simultaneously with one or two circulating pumps operating.

Because of more-than-half-a-century of experience in condenser design and maintenance, C.H. Wheeler is unusually well qualified to advise on condenser efficiency and maintenance problems. We invite your inquiry, whether you're concerned with condensers or with circulating and condensate pumps and other auxiliary equipment. A note on your company letterhead will receive prompt attention from us.

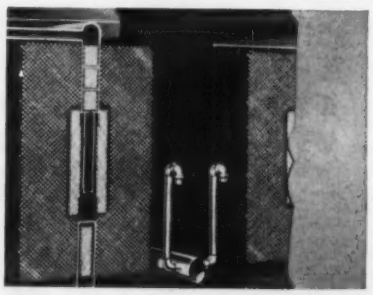


Figure 4: Central location of air cooler section in C.H. Wheeler Condensers reduces depth of steam penetration and therefore lessens resistance to steam passage, achieving a new low in pressure loss in the condenser.

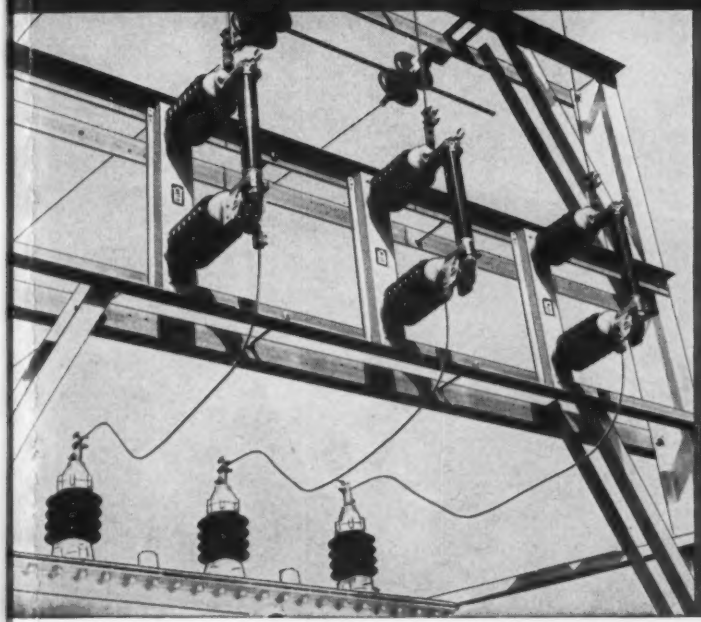
C. H. WHEELER MFG. CO.

19th and Lehigh Avenue • Philadelphia 32, Pennsylvania

Whenever you see the name C.H. Wheeler on a product, you know it's a quality product.

Steam Condensers • Steam Jet Vacuum Equipment • Centrifugal, Axial and Mixed Flow Pumps • Marine Auxiliary Machinery • Nuclear Components

S&C's SM Power Fuses redesigned for new, higher interrupting ratings!



1,000,000 kva
at 34.5 kv

750,000 kva
at 23 kv

500,000 kva
at 14.4 kv

A new principle in boric acid circuit interruption has been incorporated into the SM Power Fuse, to provide substantially increased ratings to match today's higher system faults. And the SM still retains the following advantages that have made it the number one choice of the electrical utilities:

1. As a power transformer primary fuse, the SM can give you two-fold protection—to transformer and to system; the fuse has time-current characteristics which permit selective operation (coordination) with source and load (secondary) relays.

2. The SM Fuse can be re-fused at nominal cost.

3. The SM Fuse may be applied at any voltage up to its rating. It is not "voltage-critical."

4. In blowing, the SM Fuse does not bring about excessive voltage surges that will interfere with lightning arrester application.

5. The SM Fuse cannot be damaged by surges, ageing, or vibration.

6. The SM Fuse can interrupt the complete range of fault currents—from the lowest current that will sever the fusible element to the maximum rating of the fuse.

For further information, write to S&C Electric Company, 4421 Ravenswood Ave., Chicago 40, Ill. In Canada: S&C Electric Canada, Ltd., 8 Vansco Road, Toronto 14, Ontario.

Specialists in High-Voltage Circuit Interruption Since 1910

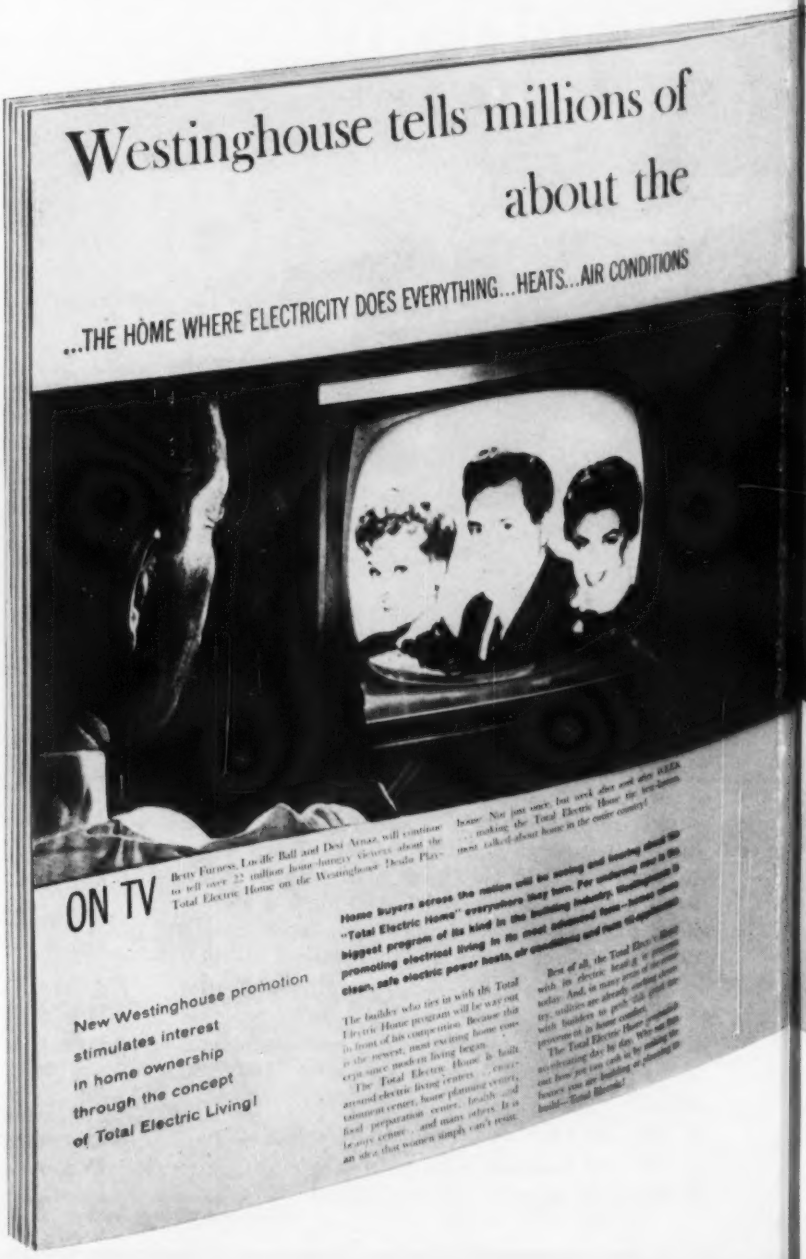
S&C POWER FUSES

Disconnects • Cutouts • LOADBUSTER® • Interrupters • Metalclad Switchgear • Fuse Links • Power Fuses

NOW IN FULL

Westinghouse TOTAL ELECTRIC HOME program

HERE'S WHAT WE'RE SAYING TO BUILDERS THIS MONTH in House and Home, Practical Builder, and American Builder


Westinghouse tells millions of
about the
...THE HOME WHERE ELECTRICITY DOES EVERYTHING...HEATS...AIR CONDITIONS
ON TV
New Westinghouse promotion stimulates interest in home ownership through the concept of Total Electric Living!

YOU CAN BE SURE...IF IT'S

SWING...

backed by a Three Million Dollar Campaign

Westinghouse

TOTAL ELECTRIC HOME DEPT.,
3 GATEWAY CENTER, PITTSBURGH 30, PA.

AND HERE'S WHAT WE'RE OFFERING YOU TO GET A TOTAL ELECTRIC HOME PROGRAM ROLLING IN YOUR AREA

1. An opportunity for your company to "cut in" locally on 20 television commercials on the Westinghouse Desilu Playhouse . . . thereby making them *your* commercials.

2. Total Electric Home book. 44 pages in full color for distribution to your customers. Westinghouse supplies these books at cost.

3. Reprints of a 3-page, 4-color advertisement in this week's (June 22) issue of LIFE reaching over 32 million readers.

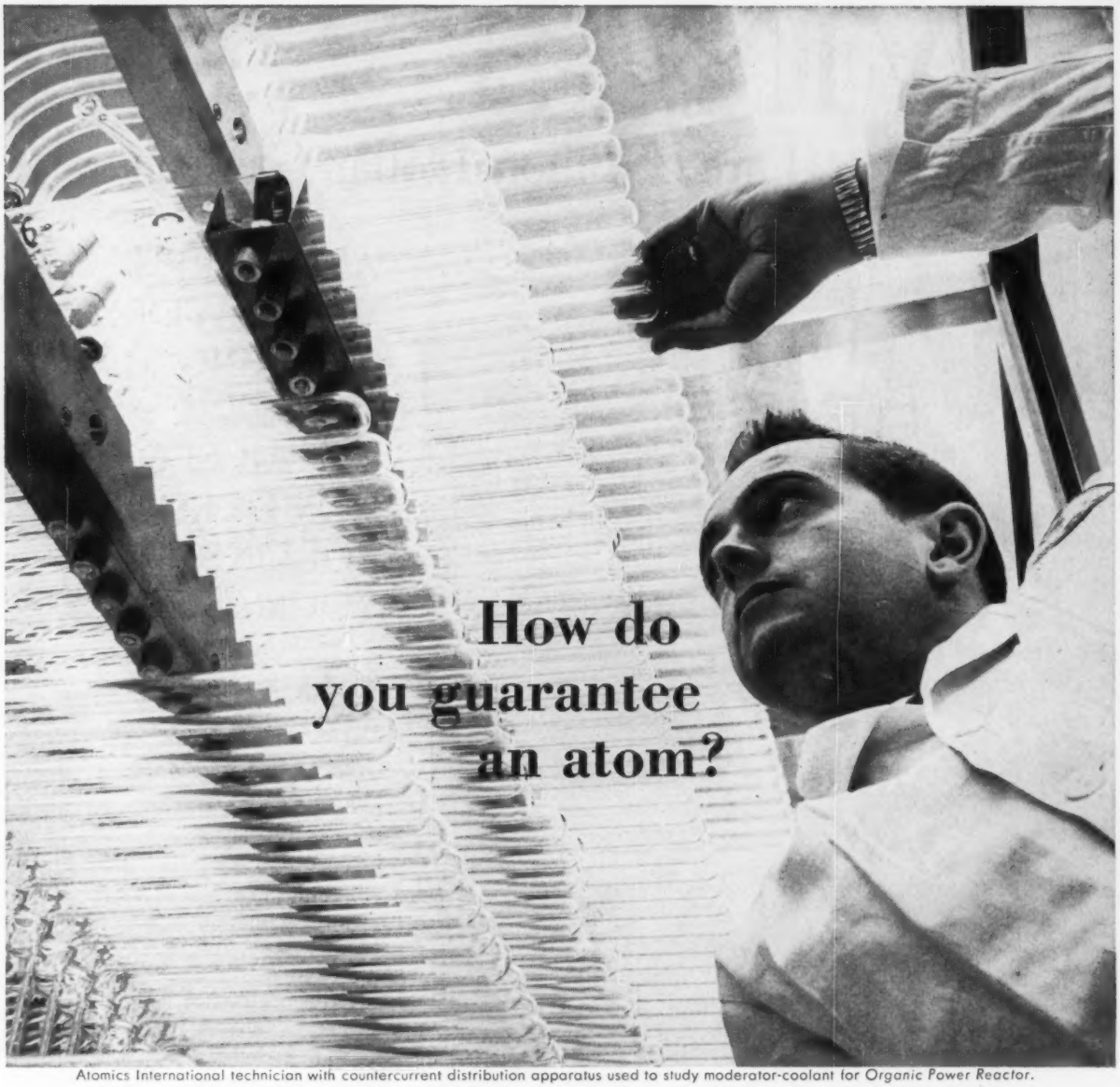
4. Repro book of suggested newspaper advertisements which can run over your company's signature.

5. *Plus*, the experienced assistance of Total Electric Home Managers, backed up by the complete sales facilities of Westinghouse.

THE TOTAL ELECTRIC HOME Program, now in full swing, offers you an important load-building opportunity. We invite your inquiry.

Westinghouse
TOTAL ELECTRIC HOME
HEATING · COOLING · LIGHTING · APPLIANCES

MEDALLION HOME
LIVE BETTER ELECTRICALLY



Atomics International technician with countercurrent distribution apparatus used to study moderator-coolant for *Organic Power Reactor.*

Begin with the knowledge of experienced scientists... conduct a seven-year research and development program ...collect a wealth of solid operating experience. Result: GUARANTEED PERFORMANCE of a nuclear power reactor, designed by Atomics International to help meet the world's power needs.

This is the ORGANIC POWER REACTOR—outgrowth of research and development on the organic system and operation of the Organic Moderated Reactor Experiment (OMRE) conducted by Atomics International for the U.S. Atomic Energy Commission.

Outstanding advantages of the ORGANIC POWER REACTOR: Low capital investment • Low cost operation • High inherent safety and flexibility • Reliability resulting from

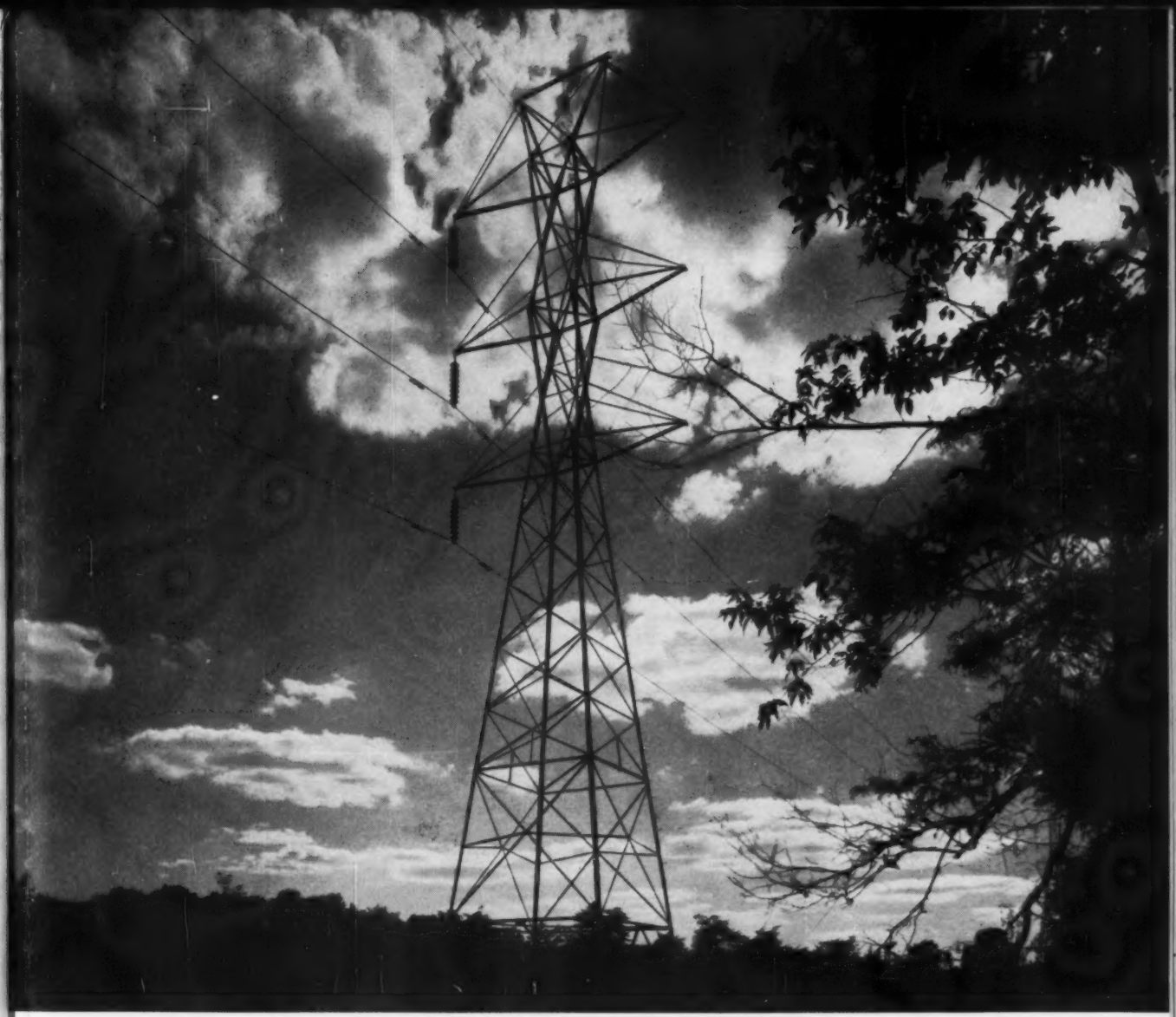
- **Non-corrosive moderator coolant**
- **Low pressure system**
- **Conventional, off-the-shelf components and materials**
- **Easy access during operation**

Atomics International is ready to furnish complete ORGANIC REACTOR electric power plants, including fuel elements, in a wide range of power levels. An experienced field staff will assist with initial plant operation, personnel training and maintenance procedures.

For details contact: ATOMICS INTERNATIONAL, Canoga Park, California, U.S.A. Cable address: ATOMICS.

ATOMICS INTERNATIONAL
A DIVISION OF NORTH AMERICAN AVIATION, INC.
PIONEERS IN THE CREATIVE USE OF THE ATOM

Other offices in: Washington, D.C., U.S.A.; Geneva, Switzerland. Affiliated with: INTERATOM, Bensberg/Cologne, Federal Republic of Germany



Blaw-Knox Double Circuit Tower — first circuit installed; built-in provision for second circuit when needed

To expand an existing line . . . to build a new line . . .

they chose BLAW-KNOX TOWERS

To feed the output of a new unit at the Picway Generating Station into their 138 kv system and to meet the demand in a growing residential area, Columbus and Southern Ohio Electric Company approved construction of two new transmission lines. For both lines, they chose Blaw-Knox towers.

The 138 kv line from the Picway Generating Station to Harrison Switching Station, a distance of one mile, required one 100′ single circuit tower and five double circuit towers varying from 50′ to 95′ in height.

The 10 mile, 138 kv line from Wilson Road to Bethel Road Substations is carried on 50 double circuit towers from 50′ to 85′ in height.

For more than 40 years, Blaw-Knox has worked closely with Electric Utilities in designing and fabricating towers for every type of transmission system. From this experience have evolved basic designs combining maximum structural advantages and ease of erection with unique allowances for custom modification. The performance record of Blaw-Knox Towers assures you . . .

- **towers custom designed to best meet your individual requirements**
- **high quality fabrication for easy field erection**

Send today for Folder 2509 . . . or tell us your needs, and we'll give you our recommendations and a quotation.

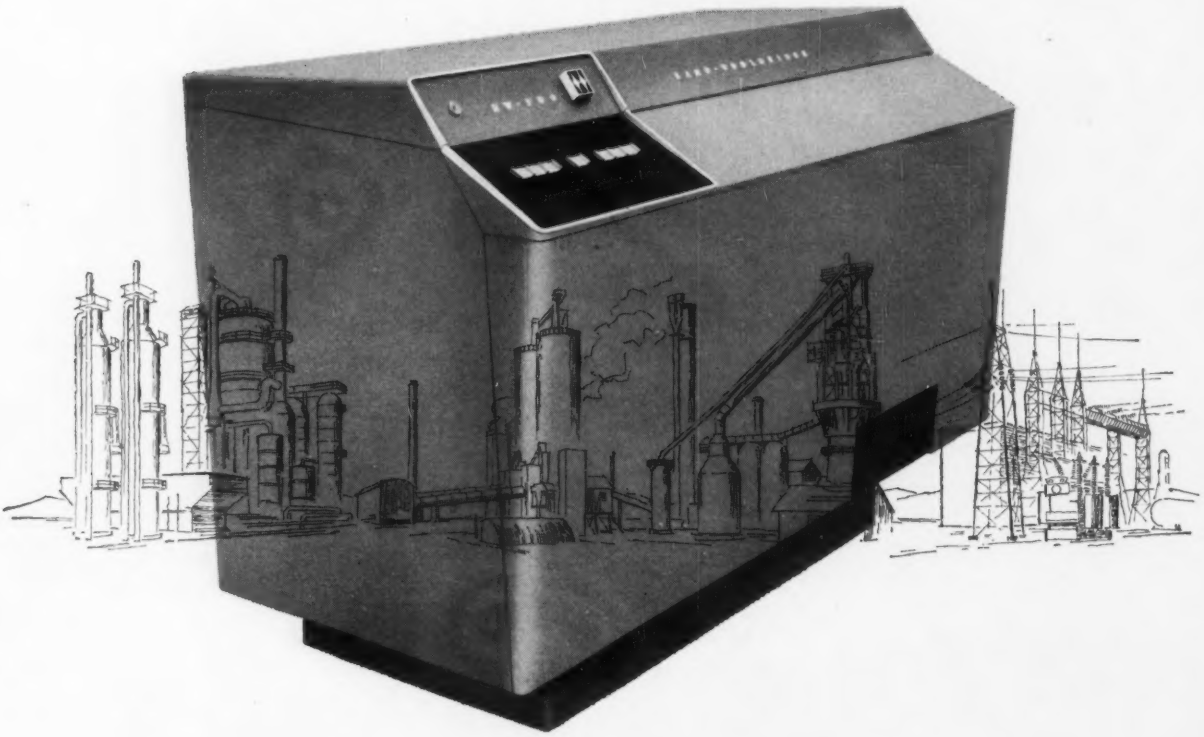
BLAW-KNOX COMPANY • **Blaw-Knox Equipment Division**
Pittsburgh 38, Pennsylvania

BLAW-KNOX

TRANSMISSION TOWERS—Steel Transmission towers, custom-built for each installation . . . multi-circuit and other special structures . . . and antenna towers, guyed and self-supporting types for AM • FM • TV • microwave • communications • radar

In a Class by Itself

FOR CLOSED-LOOP CONTROL AND AUTOMATIC DATA REDUCTION



The RW-300

DIGITAL CONTROL COMPUTER

OPERATING SYSTEMS incorporating the RW-300 for on-line control and data reduction are demonstrating these tangible benefits: *reduced costs, increased output, improved quality.*

HIGH RELIABILITY, inherent in the advanced design of the RW-300, is being proven by thousands of hours of dependable operation.

SYSTEMS ENGINEERING staff, experienced in the analysis of complex control and data reduction problems, is assisting industry with applications of the RW-300 in chemical, petroleum, steel, cement, electric power, and other fields.

NATION-WIDE SERVICE organization is providing skilled maintenance for this completely developed, production engineered, and thoroughly tested piece of *industrial* equipment.

For further information, call or write: Director of Marketing, The Thompson-Ramo-Wooldridge Products Company, P.O. Box 90067 Airport Station, Los Angeles 45, California, OSborne 5-4601.

THE THOMPSON-RAMO-WOOLDRIDGE PRODUCTS COMPANY

a division of ***Thompson Ramo Wooldridge Inc.***

Neoprene-jacketed Anaconda cable shrugs off 9 years across lime bed

Back in 1950, Wyandotte Chemical Company didn't have to bury or string up cable when they put in power for their Grosse Ile brine pumps. They just laid a 5 KV Anaconda Durasheath cable above ground. That it would lie over a bed of lime waste was of no concern, since the cable was neoprene-jacketed. Today, after exposure to weather extremes and alkalies, the neoprene is still providing dependable, trouble-free service.

The known performance of neoprene led to its use in this installation. Neoprene had a time-proven reputation for resistance to chemicals, moisture and weather.

Over 20 years of uninterrupted service in many installations give you assurance of long-term economy when you specify neoprene on wire and cable. For details, write to E. I. du Pont de Nemours and Co. (Inc.), Elastomer Chemicals Dept. EW-6, Wilmington 98, Delaware.

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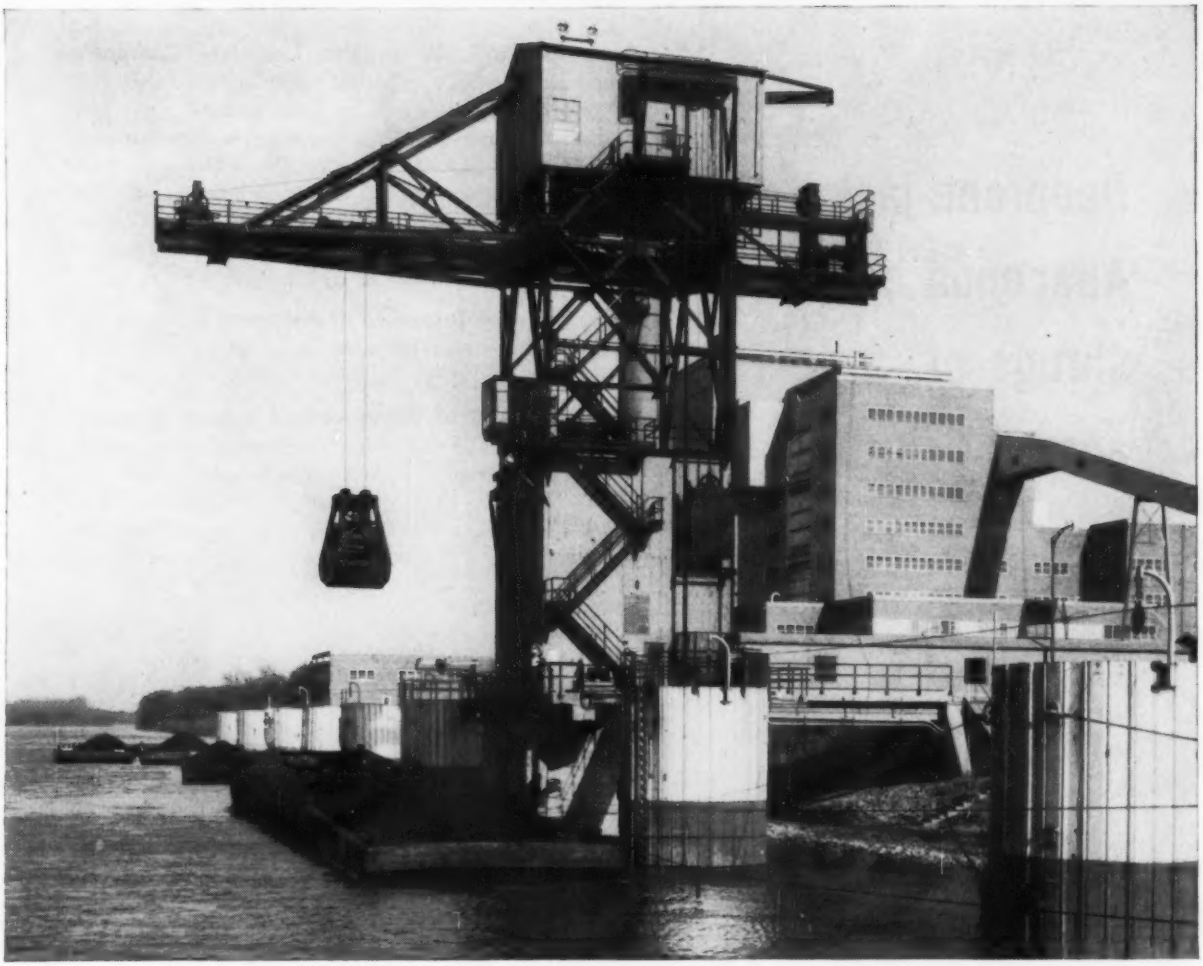
SYNTHETIC RUBBER

NEOPRENE
HYPALON®
VITON®
ADIPRENE®

Better Things for Better Living . . . *through Chemistry*



At Illinois Power Co.'s Hennepin Station:

Dravo-built coal unloader to handle 4 times original plant capacity without modification

As the Illinois Power Company quadruples the capacity of its Hennepin Station, on the Illinois River, the rewards of proper long-range planning are apparent.

Because the company, and its consulting engineers, Sargent & Lundy, planned for the future six years ago, the greatly enlarged capacity is being accomplished without need for new unloading equipment or for modification of the present Dravo coal unloader.

When the Hennepin Station was first built, it housed only a single generating unit. However, Illinois Power anticipated its load growth, and at that time installed a Dravo coal unloader large enough to handle a second unit.

The full production of the unloader could not be used with the single unit, but now that an additional 225,000 kw unit has been placed in operation, the Dravo unloader is of sufficient capacity to handle the entire production.

Whether you must build for tomorrow's requirements, or to meet the pressing needs of today, Dravo's broad experience in coal unloading equipment can help make your investment more profitable.

Complete information on this important area of utility operation is readily available. Contact Crane and Bridge Department, DRAVO CORPORATION, PITTSBURGH 25, PA.

DRAVO
CORPORATION

Blast furnace blowers • boiler and power plants • bridge sub-structures • cab conditioners • docks and unloaders • dredging • fabricated piping foundations • gantry and floating cranes • gas and oil pumping stations • locks and dams • ore and coal bridges • process equipment • pumphouses and intakes • river sand and gravel • sintering plants • slopes, shafts, tunnels • space heaters • steel grating • towboats, barges, river transportation

The Electrical Week

FUTURE NEWS ▶ **Look for a "hybrid" TVA bond-financing bill** to be voted out of Senate Public Works Committee soon. It will differ from both the House-passed bill and the Senate-introduced measure.

LATE NEWS ▶ **Washington Wire** . . . AEC Authorization Bill breezes through House and Senate in almost same form approved by JCAE . . . Sen Stuart Symington (D-Mo.), calls for U. S. to move ahead with basin-wide development of water and power potential of our rivers . . . Bureau of Mines releases power plant coal-scrubbing report aimed at reducing SO_2 air pollution . . . National Coal Policy Conference incorporates . . . Pacific G&E offers to continue Trinity River power studies in letter to Interior Secy Seaton.

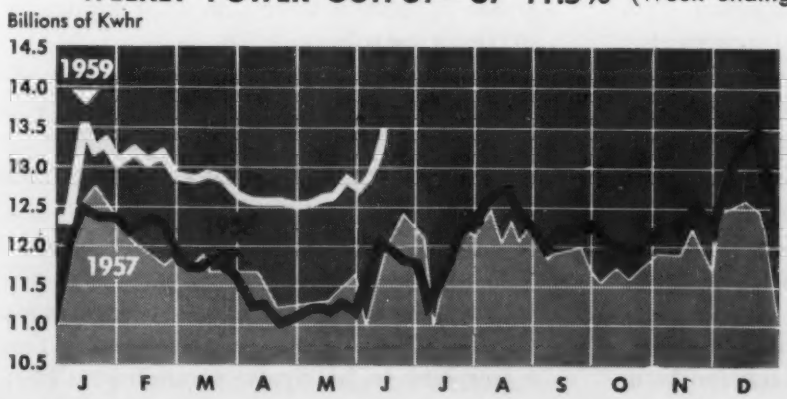
At the June Appliance Show . . . Westinghouse Vp R. J. Sargent says major appliance sales are up and that "it seems safe to predict that 1959 may be another record year, exceeding the 1956 record volume" . . . RCA Vp J. S. Beldon cautions on foreign invasion of the TV market.

Yankee Atomic Electric gets SEC okay to sell another $7 million in common stock to New England Power and 10 other stockholders.

In the Pacific Northwest . . . Army Corps of Engineers proposes higher power pool (1,510 ft) for High Mountain Sheep Dam on the Snake River, raising dam's cost from $226 million to almost $242 million . . . Washington Water Power requests rate hikes in Washington and Idaho. If granted, the increases will produce about $3 million in revenue.

Management changes . . . R. B. Johnson is new president of Hawaiian Electric . . . C. L. Clawson promoted to vp and treasurer at Tucson GEL&P . . . D. M. DeBard becomes consultant to Reddy Kilowatt.

WEEKLY POWER OUTPUT—UP 11.5% (Week ending June 13), Kwhr 13,503,000,000



Per Cent Change From Previous Year

	May 30	June 6	June 13
Total U. S.	+14.5	+11.5	+11.5
New Eng.	+15.0	+11.3	+11.4
Mid. Atlantic ..	+20.0	+15.1	+16.0
Cent. Ind.	+21.7	+17.5	+17.9
West Cent.	+10.7	+ 8.3	+11.3
Southeast	+ 8.4	+ 6.1	+ 3.7
South Cent.	+ 9.1	+ 1.1	+ 1.2
Rocky Mount ..	+ 3.7	+ 6.5	+10.0
Pacific			
NW	+15.6	+18.7	+18.7
SW	+15.4	+14.9	+15.3

Seasonally Adjusted Index 258.6

Week Ago 254.9 Year Ago 233.0

Source: Edison Electric Institute

Preview of this Issue

EVENTS ▶ **A bitter battle looms on growing U. S. market for hydro turbines,** turbo-generators, transformers and circuit breakers. The Office of Civil and Defense Mobilization turned down domestic firms' argument for new restrictions, but conceded U. S. manufacturers are essential to national defense and security **(p 56)** . . . AEC draws ten-year blueprint to weed out less promising reactor concepts; it plans to concentrate on those with best competitive advantages **(p 57)** . . . TVA opens bids on biggest lot of steam units in history **(p 57).**

SPECIAL REPORT 4TH ANNUAL NUCLEAR POWER REPORT ▶ **This year brought added definition to nuclear power concepts** and costs. EW's 4th Annual Nuclear Power Report **(p 63),** presents articles on a 300-Mw OMR plant and a planned development program on organic reactors **(p 64)** . . . a 300-Mw PWR plant designed for competitive costs in some cases **(p 68)** . . . a testimonial in behalf of the BWR concept **(p 70)** . . . a description of the first integral nuclear superheater to go into a full-size plant **(p 73)** . . . The report also reviews the year's A-power events and tabulated data on existing plants, those under construction, and those planned **(p 76).**

PROCUREMENT & PRODUCTS ▶ **Generally, business looks pretty rosy,** according to McGraw-Hill's Economic Dept. However, some of the important areas which bear

Politics and Public Power

EVERYBODY WANTS TO GET INTO THE ACT

With a little bit of luck—and the help of four powerful Senate committee chairmen (Foreign Relations, Interior, Public Works, and Joint Committee on U.S.-U.S.S.R. Water Resources)—spokesmen for the two principal public power lobbies probably will get a chance to visit Russian power installations this year as part of the U.S. delegation. Provided, of course, the Russians approve the proposed tour.

General Manager Clyde Ellis of the National Rural Electric Cooperative Assn, and General Manager Alex Radin of the American Public Power Assn are both eager to go with the next group to tour Russia's power projects.

Any tour of the Soviet Union must be made by October, when winter sets in. Actually, negotiations over the itinerary of the next U. S. tour already are in a deep freeze, and the outlook for any tour this year is questionable.

Both the State and Interior Departments, which are handling the East-West power tours, have urged that the next U.S. delegation be made up entirely of government people—because of the limited size of the group (12) and the large number of applicants.

Here's the rub.

Public power supporters feel that the administration's move to limit the tour only to government employees is an attempt to shut the barn door on public power officials after private power made its trip.

Why the problem? Interior and State officials say it's simple: There have been so many requests for spaces on the proposed tour that a line had to be drawn somewhere. They

watching include: inventories, housing, the end of the copper-buying spree, and a possible hike in heavy equipment prices (p 96).

MANUFACTURERS ▶ **Underground capacitors for overhead distribution**—GE has designed the units for Philadelphia Electric Co . . . Air Preheater Corp builds large preheater for Braintree, Mass., municipal . . . Griscom-Russell reveals intricate tube system for Enrico Fermi A-plant (p 100).

NEW EQUIPMENT ▶ **Lightning arrestors are available in 12, 15 and 18-kv ratings** . . . Fans provide ventilation up to 11,000 cfm . . . Generator has fast motor starting and can put out full power for standby emergencies (p 108).

ELECTRICAL BUSINESS OUTLOOK ▶ **What will a steel walkout mean to utilities?** There's no escaping the loss of steel-mill load if a strike comes off next week, but it seems unlikely that a strike will last long enough to cause shutdowns in steel-consuming industries. The settlement could have more effect on electric utilities than the strike itself (p 119).

SELLING ▶ **New England utilitymen hear about impact of new lighting levels** on utilities . . . GE's "See-Level Comparator Kit" helps customers decide for themselves the desireability of higher lighting levels (p 125).

would take one man each from Tennessee Valley Authority, Bonneville Power Administration, Federal Power Commission, Army Corps of Engineers, Bureau of Reclamation, and the Interior and Public Works committees of the Senate and House. The remaining three billets probably would be filled by interpreters and stenographers, and maybe a special government representative. The original purpose of the East-West Power Exchange Agreement, signed in January, 1958, was for "technical evaluation," and administration officials feel this all-government team would be qualified for the job.

Last year's private power tour was the first under the exchange agreement. It was privately organized and financed; and it was sponsored by the State Department to get the program rolling.

To expand now the size of the next tour, or to permit non-governmental representatives might lead to difficulties with Russian red tape because the rules have been changed, says the administration. This could jeopardize the entire delegation. One possibility, they suggested, would be to make Ellis and Radin consultants to the Congressional committees, but this hasn't been worked out.

Another Russian tour was snowed out last November. Ellis and Radin were both on that one, and public power officials can't understand why the same delegation should not be sent again this year.

Regardless of the theorizing, now that pressure has been brought to bear by the four Senate leaders—Fulbright, Murray, Chavez and O'Mahoney—you will probably be hearing Ellis' and Radin's first-hand reports on Russian power developments before the snows come this fall—provided, of course, the Soviet Union opens its arms to them.

Executive Reader

Untimely death on the job during 1958 came to 30 employees of rural electric systems who were not wearing rubber gloves when they should have been doing so. Most of them could be alive and working today if management had done a proper job of teaching and enforcing safety rules and regulations. **David A. Hamil, REA Administrator, Rural Lines (special safety issue) June 1959, REA, Dept of Agriculture, Washington 25, D. C.**

Sea-water conversion plant serving as "condensers" for a high-pressure steam-electric station could distill a lot of sea water using 5-psig steam. Preliminary indications are that such a combination would produce fresh water for about 60¢ per 1,000 gal. **Sea Water Distillation with By-Product Power at Aruba, G. E. Sonderman, ASME Semi-Annual Meeting, St. Louis, June 14-18.**

A 10% drop in service voltage causes an average 5% revenue loss. Studies show about one-third of residential types of load are voltage-sensitive, with consumption varying as the 1.6 power of the voltage. In computing cost of regulation, this should be recognized. **D. H. Mullen, Westinghouse Electric Corp, Rocky Mountain Electric League Spring Conference, Denver, April 20, 1959.**

NUCLEAR NOTES

First joint American-European commercial organization specifically set up to produce nuclear fuels for the Euratom market brings together Sylvania-Corning Nuclear Corp, US manufacturer of nuclear fuels and reactor parts, and CERCA, a French firm owned by Saint Gobain, Pechiney, and SFAC, leading glass, chemical and steel manufacturers. Association of Sylcor with CERCA is intended to implement US assistance to the Euratom community. **Dr Lee L. Davenport, president, Sylvania-Corning Nuclear Corp.**

Although not favoring location of power reactors near populated areas, AEC's Committee on Reactor Safeguards has okayed the site now proposed for Piqua, Ohio's 11,400 (e)kw organically-moderated and cooled reactor if additional containment is constructed and also if maximum leakage rate for the containment is reduced to an acceptable low value. Contracts for $8.7 million have been signed by AEC with the City of Piqua and with Atomics International in connection with the municipal nuclear plant. **John A. McCone, chairman, Atomic Energy Commission.**

They roll with the punch!

It's simple to say "I'm all done" when you have designed a bushing for normal service. This is not true. One of the toughest chapters in a bushing's life is getting it to its work. It travels on trucks or freight cars. It may have a heavy 'ruptor mechanism attached to its lower end. It may be loaded and unloaded several times by freight handlers who don't exactly give it "kid glove" treatment. It gets still more handling on the construction site.

Powerful endwise compression, developed by *coil* springs -- an original O-B development -- keeps bushings tight and perfectly aligned against any lateral movement in spite of severe accidental shocks. In the extreme case, the assembly can give and recover because coil springs permit slight movement under constant sealing pressure without damage to themselves or to other parts. Briefly, O-B bushings can "roll with the punch."

This gets O-B bushings onto the job in the same condition they left the factory -- a mighty important thing for bushing users to think about -- especially in the case of O-B where *no better bushing* comes out of *any factory*.

It is easy to avail yourself of this extra advantage. Just express your bushing choice when you purchase new station apparatus. Say, "O-B equipped." Name it, and you can have it!

OHIO BRASS COMPANY, MANSFIELD, OHIO

Ohio Brass HOLAN

PORCELAIN INSULATORS • LINE HARDWARE • CAPACITORS • LIGHTNING ARRESTERS
BUSHINGS • HOLAN TRUCK-MOUNTED POWER DEVICES AND BODIES • BRONZE VALVES

4923-H1

5 years of operation at the Possum Point Power Station of...

VIRGINIA ELECTRIC and POWER COMPANY

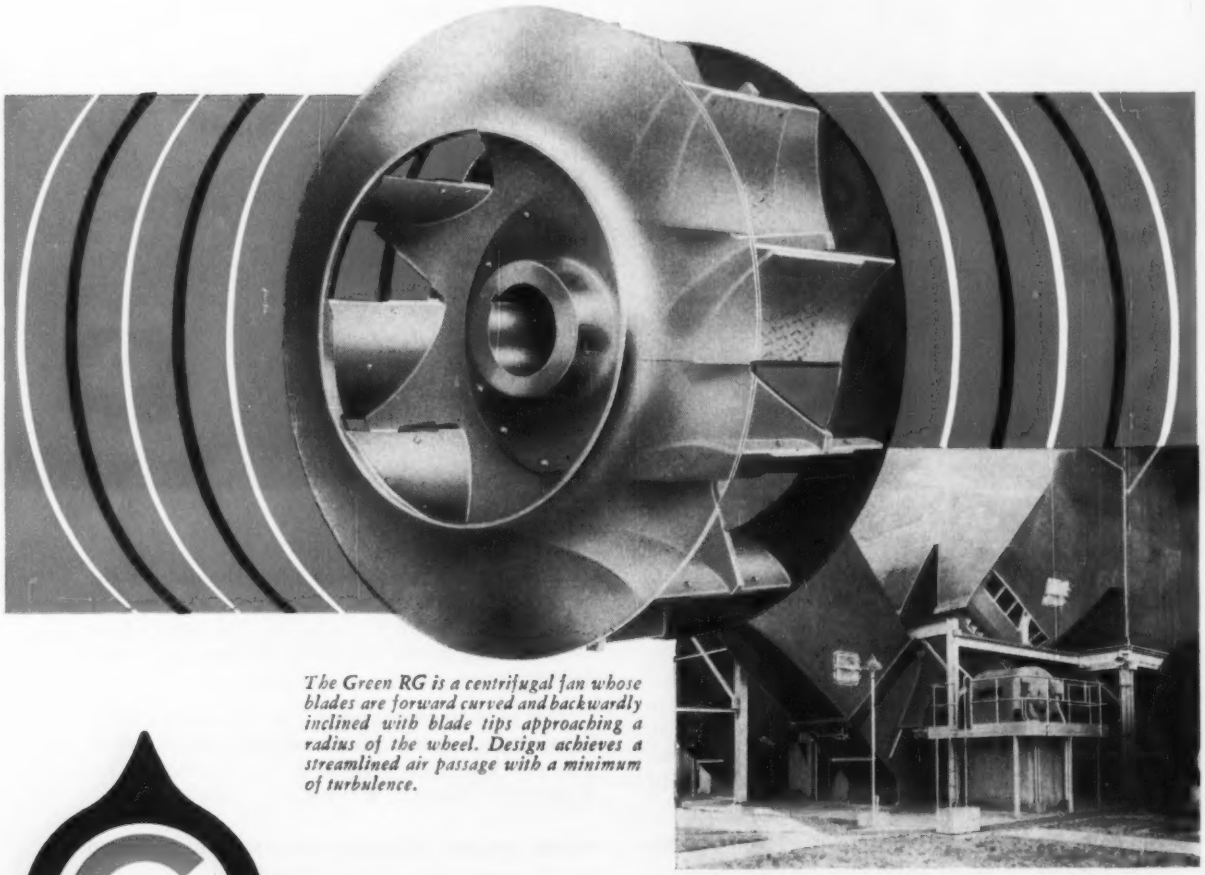
With Green RG Fans, of course.

Somehow, you just expect Green fans to give years of trouble-free operation.

When Virginia Electric and Power Company planned their Possum Point Power Station, with Stone & Webster consulting, they selected Green RG Fans for both induced and forced draft.

Green RG Fans are rugged, reliable, self-cleaning and accessible.

When you want trouble-free fan performance — consult Green.

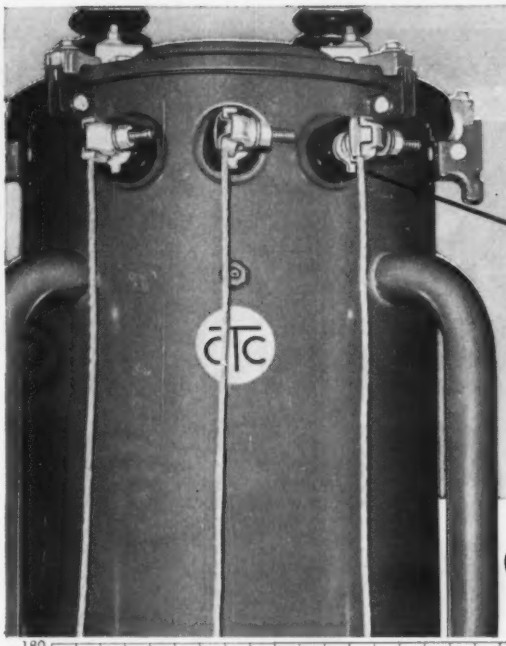


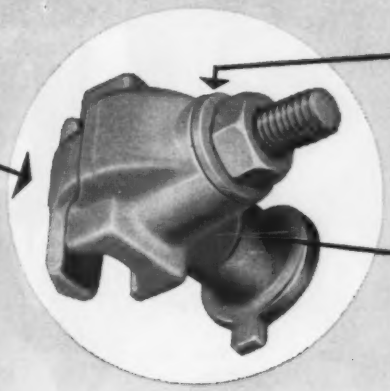
The Green RG is a centrifugal fan whose blades are forward curved and backwardly inclined with blade tips approaching a radius of the wheel. Design achieves a streamlined air passage with a minimum of turbulence.

This is the induced draft Green RG Fan installation at the Possum Point Power Station. ¼" housing and inlet boxes. ½" scroll liners. Diamond checkered floor plate blade liners. Air-cooled, self-aligning sleeve bearings. 600 HP, 880 RPM motors.

Green

THE GREEN FUEL ECONOMIZER CO., INC. BEACON 3, NEW YORK

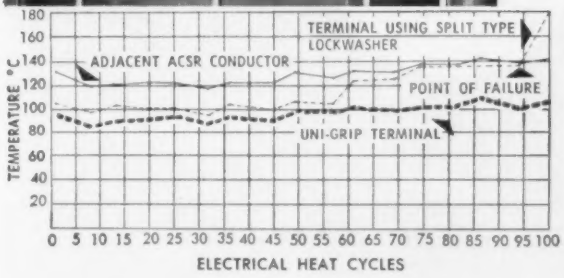


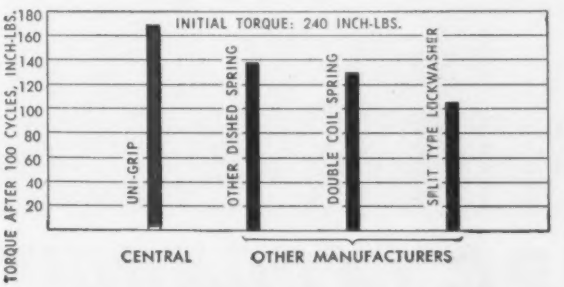


EXCLUSIVE! High carbon steel dished washer of special design, zincplated with chromate conversion. Maintains pressure, compensating for aluminum conductor "cold flow".

Flowed tin plating on bronze body and eyebolt assures maximum compatibility corrosion-wise with either aluminum or copper conductors.

Central's New "UNI-GRIP" Transformer Terminal Solves Your Aluminum Clamping Problems!





HEAT CYCLING AND TORQUE TESTS PROVE SUPERIOR PERFORMANCE OF CENTRAL'S NEW TERMINAL FOR USE WITH BOTH COPPER AND ALUMINUM CONDUCTORS!

Central's revolutionary new universal terminal—"UNI-GRIP"—represents the most outstanding advancement to date in solving the problems of clamping aluminum conductor.

Its superior performance over other types of terminals has been established by extensive heat cycling and torque tests.

"UNI-GRIP" combines a new spring washer, flowed tin plating and increased contact area.

Central's new terminal was designed and perfected by Anderson Electric Corporation, Birmingham, Alabama, in cooperation with Central engineers.

PLUS . . . ALL STANDARD FEATURES

- Components are quality-control-tested by ASTM's Mercurous Nitrate Specification B154-51 to insure against stress corrosion cracking, and season cracking.
- Connector contact design configuration correct to prevent separation of conductor strands.
- Contact surface areas sufficiently large and smooth to prevent damage to conductor under pressure.
- Eye-Bolt entrance rounded to prevent cable damage.
- Bushing, terminal and transformer tank interlocked to prevent turning.

Just one more reason why Central Transformers are **PREFERRED** *throughout the Nation*

CENTRAL

Sales Offices in Principal Cities
Transformer Corporation
Telephone JEfferson 4-5332
PINE BLUFF, ARKANSAS

New ORANGEBURG® CA* CONDUIT *with Flush Coupling Attached!*

With no separate couplings to handle or attach on the job, Orangeburg CA lays faster, costs less to install. Each long, light length has a *flush* coupling attached at one end and a standard 2° male taper at the other end, making installation a simple, one-step operation. And, since the coupling *is* attached, there are no coupling cartons to warehouse or carry to the job.

What's more, with the coupling *flush* to the conduit's outside wall, new CA is easy to stack, store and handle. The flush coupling also eliminates "staggered" joints in the trench. And that means real savings in cutting and tooling time.

Like the hundreds of millions of feet of Orangeburg fibre conduit in use since 1893, new CA has self-sealing joints and impermeable walls. Its smooth, 100% fibre raceway adds years to cable life.

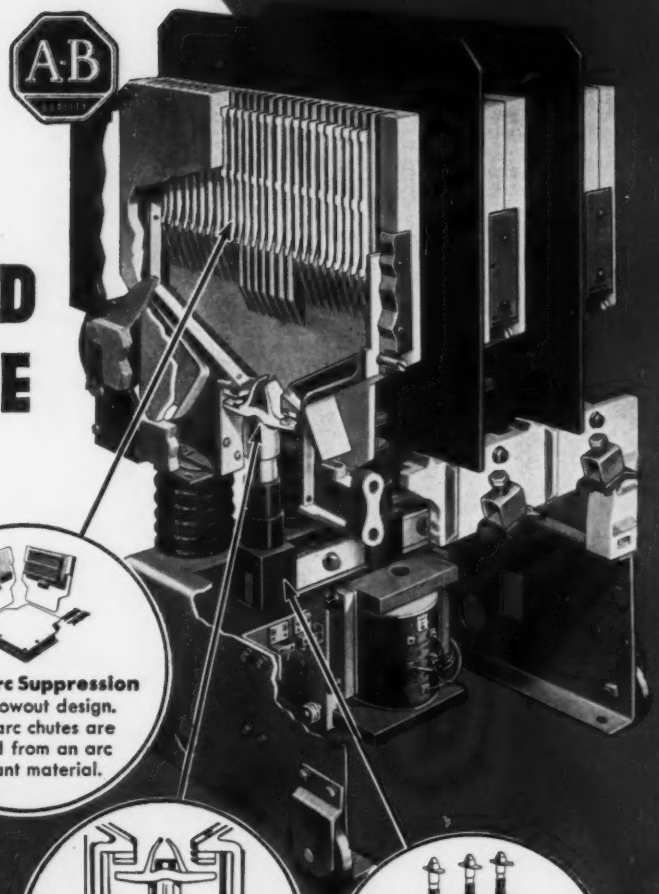
New Orangeburg CA is available in 2", 3", 4", 4½" and 5" sizes. Orangeburg Standard and Nocrete Conduit, with separate sleeve couplings, are available as always. Write Dept. EW-~~69~~ for Catalog 52.

ORANGEBURG MANUFACTURING CO.
Orangeburg, New York • Newark, California
A Division of The Flintkote Company, Manufacturers of America's Broadest Line of Building Products

Orangeburg Fibre Conduit is distributed by Graybar Electric Co. and General Electric Supply Co. with branches and stocks in principal cities.

Here's the inside story of industry's

MOST RUGGED HIGH VOLTAGE SWITCH



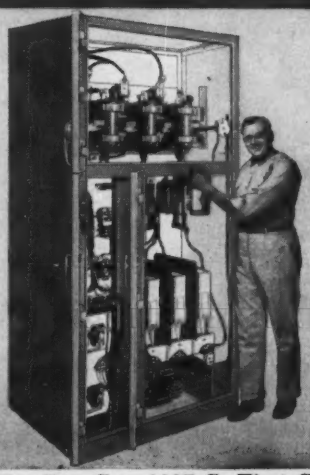
THIS SOLENOID AIR BREAK CONTACTOR IS THE HEART OF THE A-B STARTER LINE

A tremendous operating life has been built into these new A-B high voltage, air break starters by using the same simple solenoid design—with only one moving part—that has proved good for millions of trouble free operations in Allen-Bradley low voltage starters. A-B high voltage starters are made for all types of service and for all types of motors up to 1500 hp, 2300 v; 2500 hp, 4600 v. Send for Publication 6030, today.

Faster Arc Suppression
New blowout design. Novel arc chutes are molded from an arc resistant material.

Double Break Contacts
Silver alloy contacts never need maintenance. Vertical motion assures uniform contact pressures.

Only One Moving Part
Simple solenoid design eliminates trouble-causing pins, pivots, and flexible jumpers.



A-B High Voltage Starter with Air Break Contactor

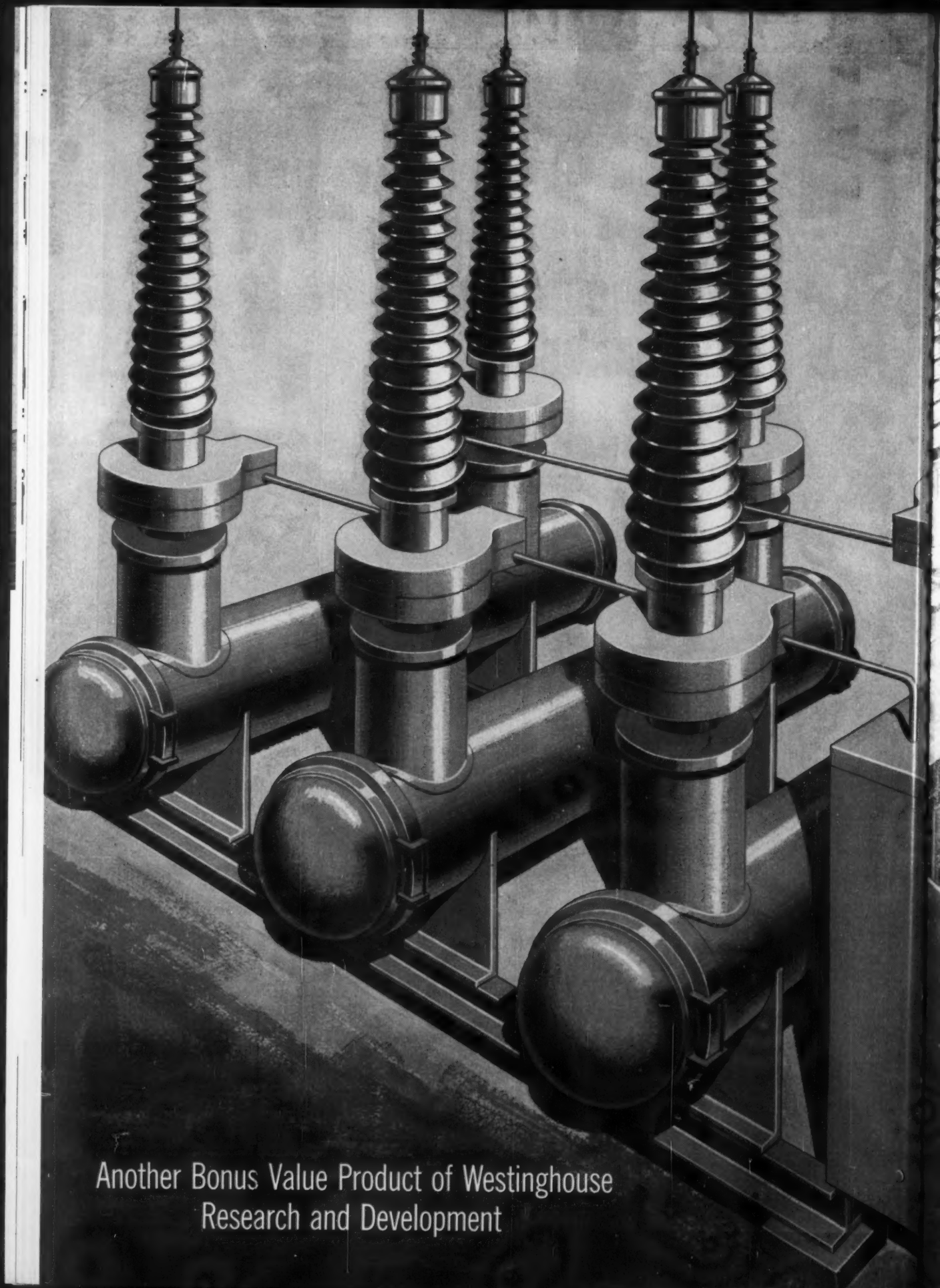
Bulletin 1139 high voltage air break, across-the-line induction motor starter in NEMA Type 1 enclosure. All Allen-Bradley high voltage starters are equipped with current limiting fuses with interrupting capacities of 150,000 kva at 2300 v; 250,000 kva at 4600 v.

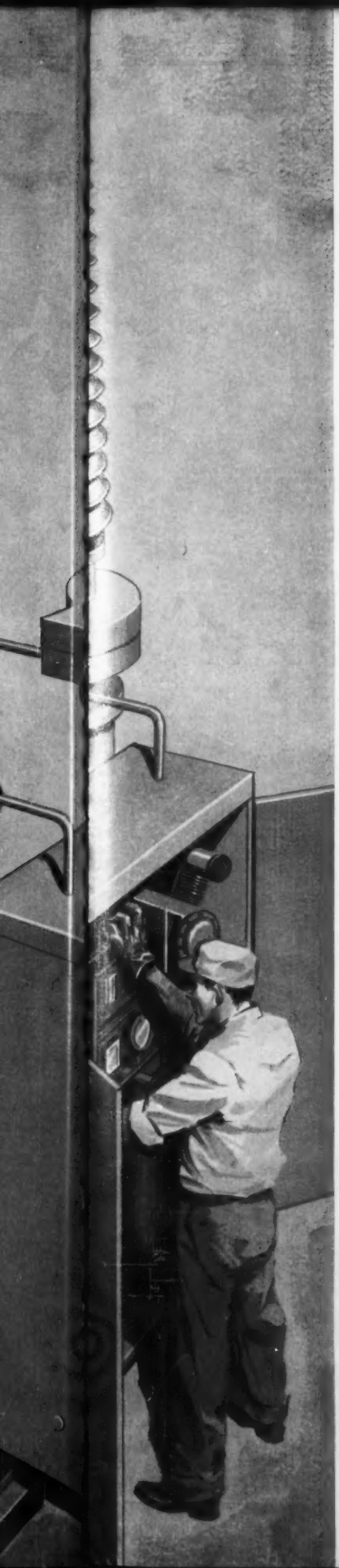
ALLEN-BRADLEY

Member of NEMA

Quality Motor Control

Allen-Bradley Co., 1327 S. First St., Milwaukee 4, Wis. In Canada: Allen-Bradley Canada Ltd., Galt, Ont.


Another Bonus Value Product of Westinghouse
Research and Development



WESTINGHOUSE ANNOUNCES

New Power Circuit Breaker Using SF_6 Gas

The Only Significant Advance in Circuit Interruption Techniques in Over 15 Years

A revolutionary 230-kv, 15 million-kva, high-capacity circuit breaker, using sulphur hexafluoride (SF_6) as the extinguishing medium, has been developed at the Westinghouse High Power Lab. This new interrupting technique will permit higher breaker ratings and much longer, more economical operating life than present designs.

This unique new horizontally mounted breaker brings the industry many radical design innovations with important savings in installation and maintenance.

Drastically slashes maintenance. This unusually stable gas does not decompose, and thus its life is not the controlling factor in time between maintenance. The interrupter assembly can be easily removed at ground level for inspection and maintenance — no scaffolding is required.

Allows simplified foundations. There is no energy transfer to foundation during interruption. Reduced size and elimination of oil has reduced weight of 230-kv gas breaker by 65 percent.

Dead tank construction provides complete safety.

Inexpensive, overlapping protection with bushing-type current transformers available on both sides of breaker.

Quiet operation. The breaker has a closed gas system, thus no discharge to atmosphere, which keeps the noise to a level comparable to the oil breaker. The closed system also conserves gas and prevents contamination.

The outstanding advances in this new breaker design are made possible because of the unusual characteristics of sulphur hexafluoride gas as an extingiushing medium:

SF_6 rapidly recovers dielectric strength because of exceptional affinity for electrons . . . assures unexcelled arc extinction.

SF_6 is extremely stable . . . thus assuring long life of the insulating and interrupting medium.

SF_6 has high dielectric strength . . . at only 10 psi, it is equivalent to oil or to compressed air at 150 psi.

SF_6 is nonflammable . . . completely safe for crowded urban substations.

SF_6 is inert, nontoxic and odorless.

This new 230-kv breaker is the first of a complete line of high-capacity SF_6 breakers. To learn how SF_6 can bring new economies to your system, call your Westinghouse sales engineer, or write Westinghouse Electric Corporation, P.O. Box 868, Pgh. 30, Pa.

J-60962

YOU CAN BE SURE... IF IT'S Westinghouse

WATCH "WESTINGHOUSE LUCILLE BALL DESI ARNAZ SHOWS" CBS TV MONDAYS

R. C. Boyd, R. E. Friedrich and B. P. Baker inspect the interrupter components of the new SF_6 breaker. A high-velocity flow of gas is directed through this formed Teflon orifice to extinguish the arc.

CRESCENT AND CRESTOLOY
outsell all other ADJUSTABLE WRENCHES

CRESTOLOY Wrenches are forged from a special alloy steel permitting thinner, trimmer design with greater strength and less weight than conventional types. They are available in Single End patterns, 4″ to 24″ size. Double-end in four models combining 4-6; 6-8; 8-10; 10-12 inch sizes. The 15″, 18″ and 24″ sizes, available in Single End pattern only, are distinguished by their tapered handles. There is no stronger or finer Adjustable Wrench than CRESTOLOY.

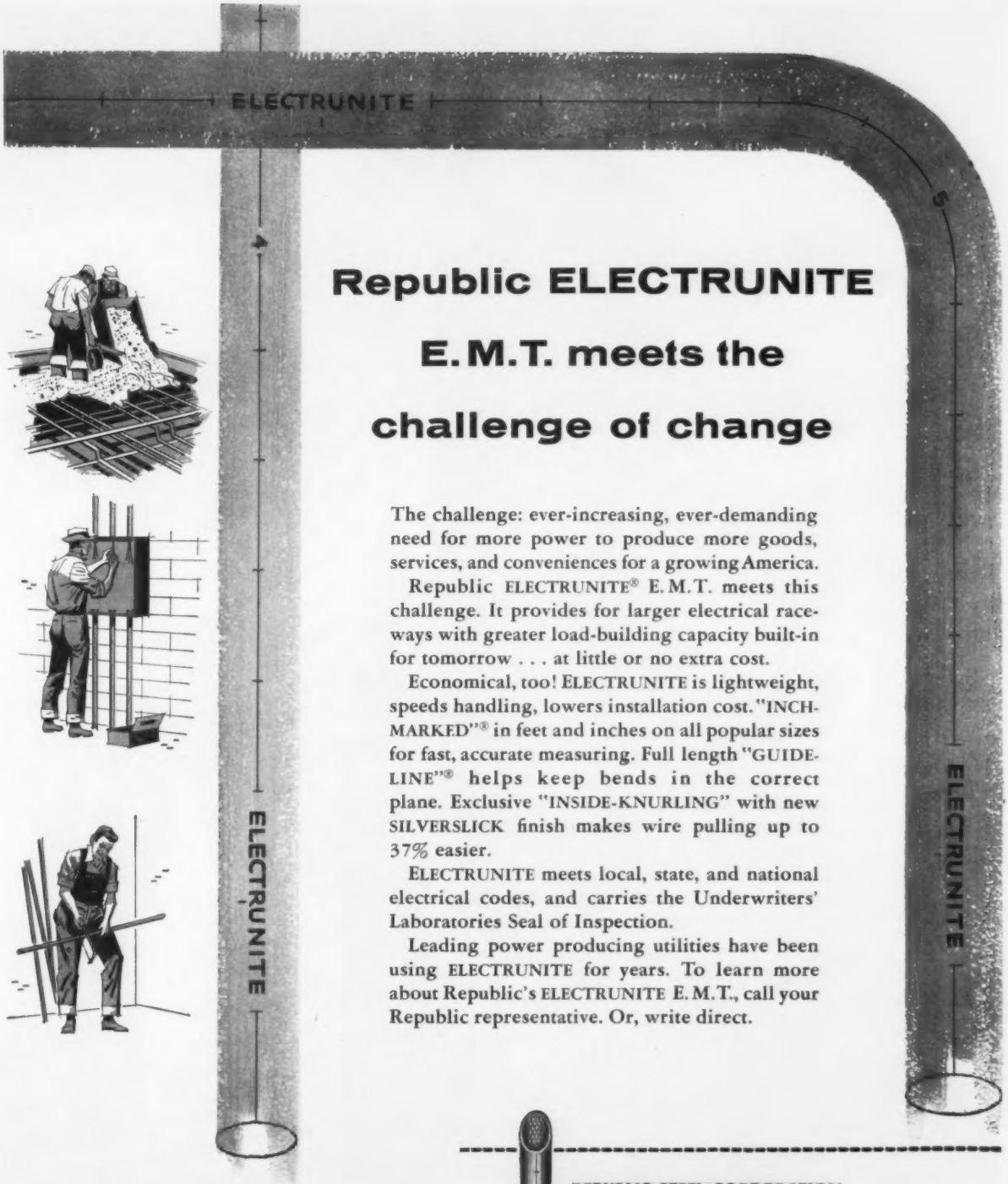
CRESCENT Wrenches are forged from special steel, particularly adapted to wrench manufacture. They are carefully heat-treated to increase their toughness and durability. Due to their lesser cost and relatively great strength, they are widely used in industrial service. Available in seven Single End Patterns, 4″ to 18″.

Both CRESCENT and CRESTOLOY Wrenches represent the best in design and workmanship, and carry the same guarantee.

CRESCENT and CRESTOLOY TOOLS are sold by hardware dealers and industrial distributors everywhere. Look for the bright yellow Crescent Display panels and select from one of the world's greatest assortments of quality hand tools.

Crescent is our trade-mark, registered in the United States and abroad, for wrenches and other tools. Sold by leading distributors and retailers everywhere and made only by

CRESCENT TOOL COMPANY, JAMESTOWN, NEW YORK



Republic ELECTRUNITE E.M.T. meets the challenge of change

The challenge: ever-increasing, ever-demanding need for more power to produce more goods, services, and conveniences for a growing America.

Republic ELECTRUNITE® E.M.T. meets this challenge. It provides for larger electrical raceways with greater load-building capacity built-in for tomorrow . . . at little or no extra cost.

Economical, too! ELECTRUNITE is lightweight, speeds handling, lowers installation cost. "INCH-MARKED"® in feet and inches on all popular sizes for fast, accurate measuring. Full length "GUIDE-LINE"® helps keep bends in the correct plane. Exclusive "INSIDE-KNURLING" with new SILVERSLICK finish makes wire pulling up to 37% easier.

ELECTRUNITE meets local, state, and national electrical codes, and carries the Underwriters' Laboratories Seal of Inspection.

Leading power producing utilities have been using ELECTRUNITE for years. To learn more about Republic's ELECTRUNITE E.M.T., call your Republic representative. Or, write direct.

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STEEL AND TUBES DIVISION
Cleveland 8, Ohio

REPUBLIC STEEL CORPORATION
STEEL AND TUBES DIVISION
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213 EAST 131st STREET • CLEVELAND 8, OHIO

I want to learn more about Republic ELECTRUNITE E.M.T. Please send additional information.

Name_____ Title_____
Firm_____
Address_____
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485 LEXINGTON AVE., New York City

URIS BROTHERS, *Owner and Builder*
ALFRED J. KLEINBERGER, *Electrical Engineer*

EMERY ROTH & SONS, *Architect*
FISCHBACH & MOORE, *Electrical Contractor*

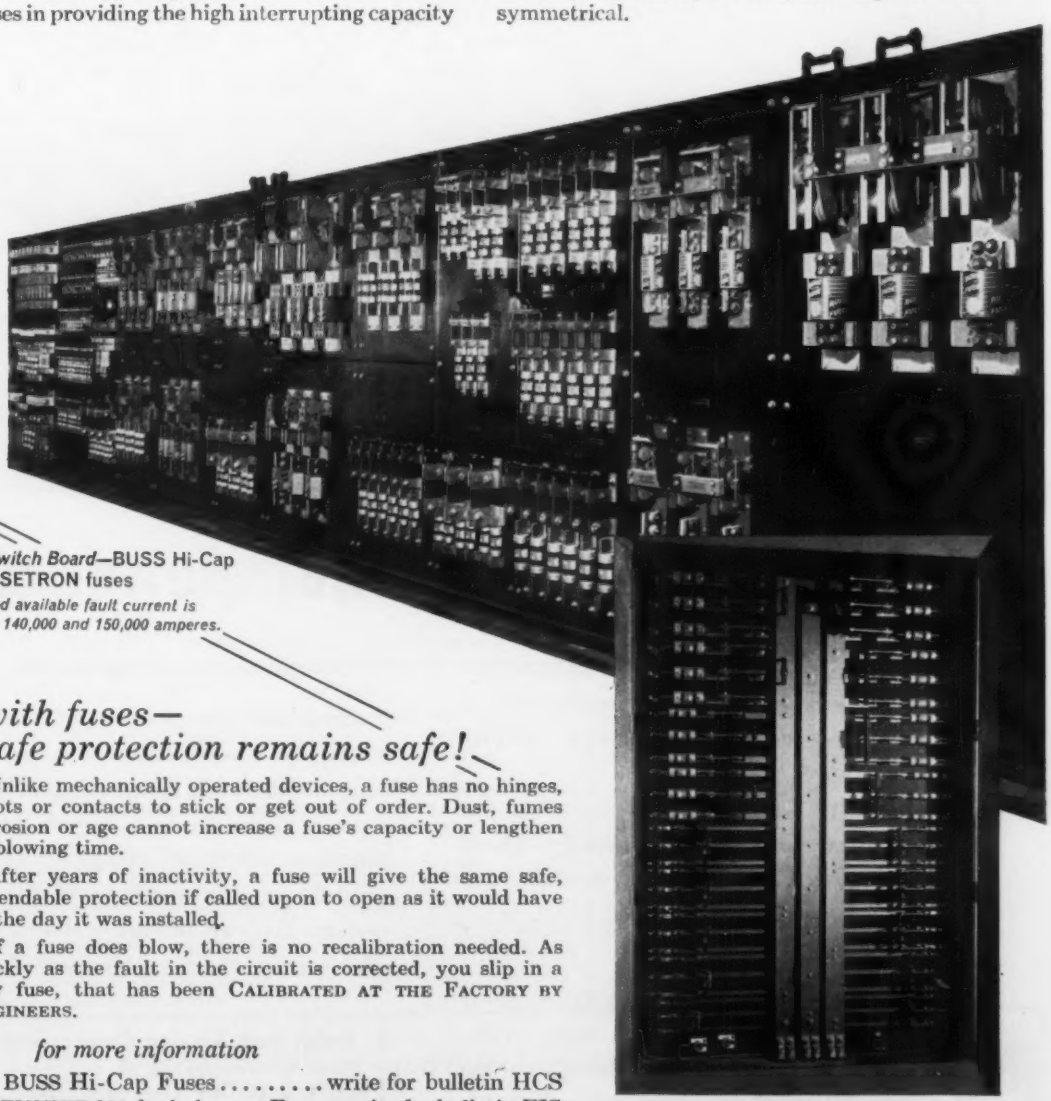
ANOTHER BUSS HI-CAP AND FUSETRON FUSE INSTALLATION

Electrical Protection goes MODERN *with* BUSS Fuses at 485 Lexington Ave., New York, N.Y.

In keeping with the modern trend the electrical protection for this new 30 story office building is BUSS Hi-Cap and FUSETRON dual-element fuses.

No other type of protective device can match fuses in providing the high interrupting capacity and dependability required for today's circuits.

BUSS Hi-Cap fuses have a NEMA interrupting rating of 200,000 amperes rms symmetrical. FUSETRON dual-element fuses have a NEMA interrupting rating of 100,000 amperes rms symmetrical.



Main Switch Board—BUSS Hi-Cap *and* FUSETRON fuses

Estimated available fault current is between 140,000 and 150,000 amperes.

Distribution Panels
PROTECTED BY FUSETRON FUSES

with fuses— safe protection remains safe!

Unlike mechanically operated devices, a fuse has no hinges, pivots or contacts to stick or get out of order. Dust, fumes corrosion or age cannot increase a fuse's capacity or lengthen its blowing time.

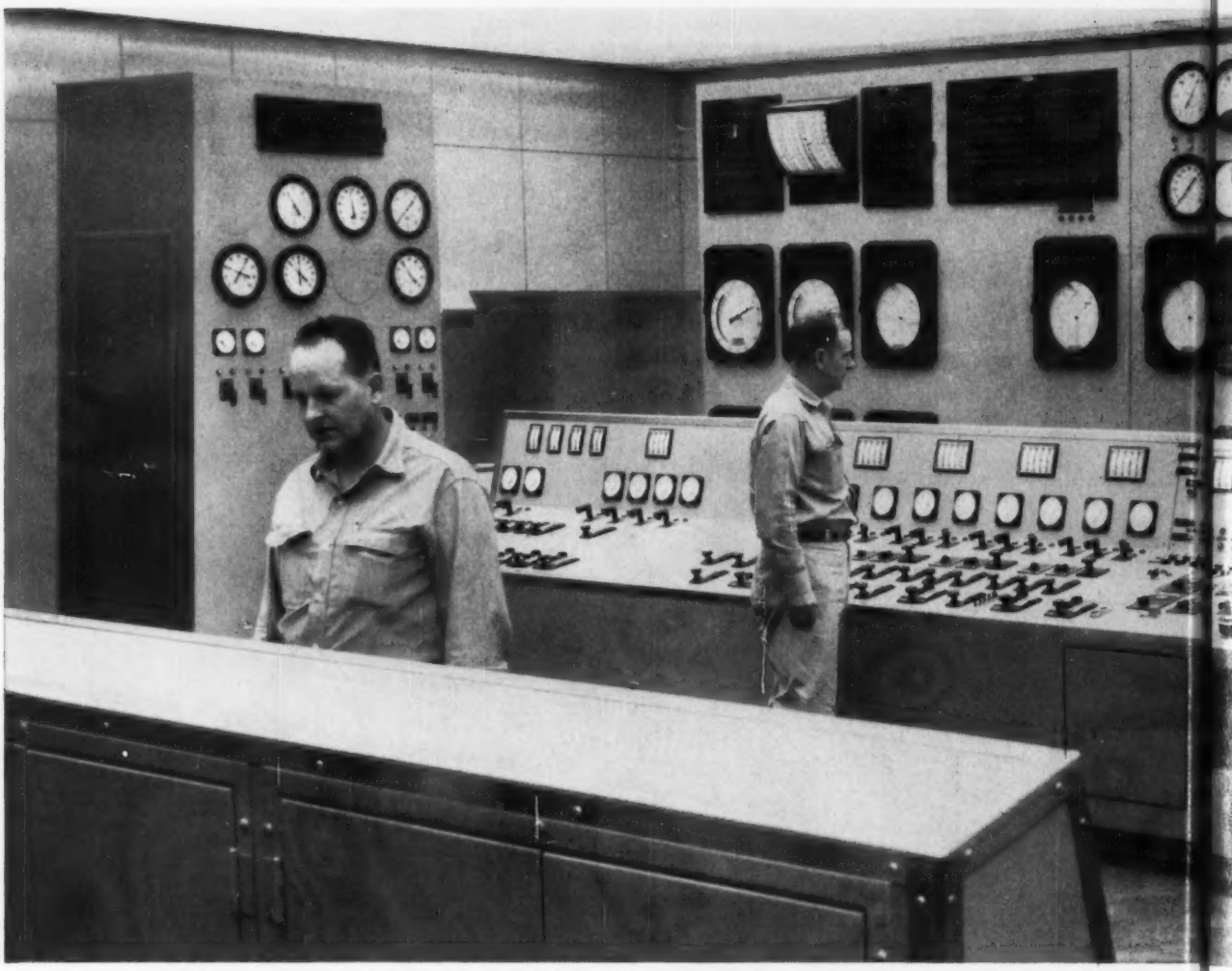
After years of inactivity, a fuse will give the same safe, dependable protection if called upon to open as it would have on the day it was installed.

If a fuse does blow, there is no recalibration needed. As quickly as the fault in the circuit is corrected, you slip in a new fuse, that has been CALIBRATED AT THE FACTORY BY ENGINEERS.

for more information

On BUSS Hi-Cap Fuses.....write for bulletin HCS
On FUSETRON dual-element Fuses..write for bulletin FIS

BUSSMANN MFG. DIV., McGRAW-EDISON CO., ST. LOUIS 7, MO.



13 of 15 "most efficient"* power plants

Year after year you'll find Bailey Meters and Controls keeping sensitive fingers on the pulse of America's *most efficient* power plants (as rated by the Federal Power Commission).

According to the latest box scores, 10 of the top 15 used Bailey equipment exclusively. There must be a reason. There is. In fact, several:

1. Experience

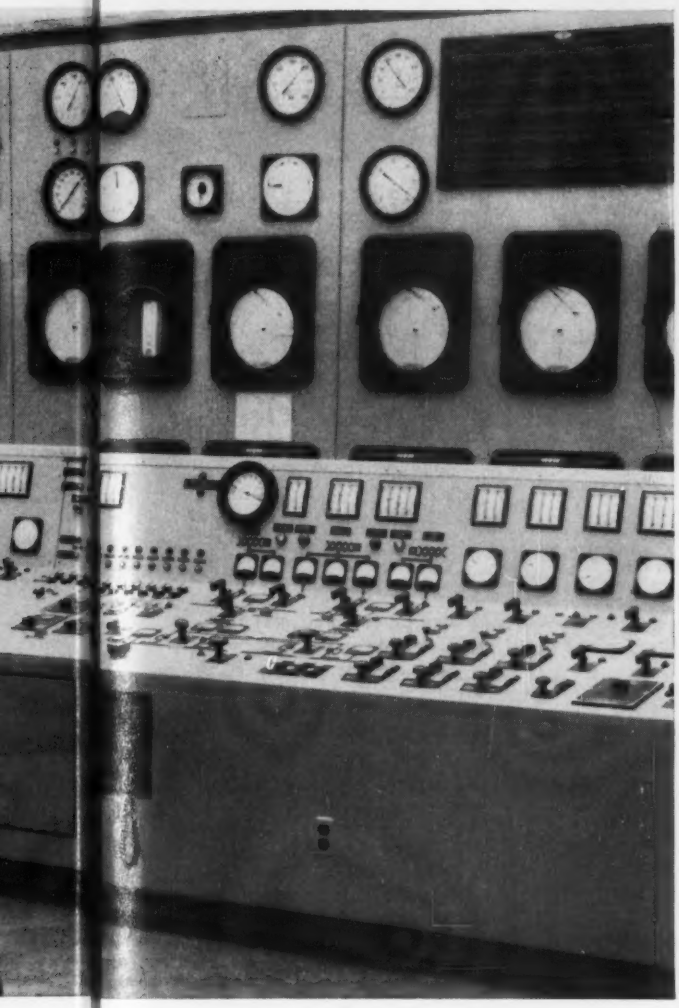
Bailey Engineers have been making steam plants operate efficiently for more than forty years. Veteran engineers and new engineers (the men who represent Bailey) are storehouses of knowledge on measurement and control. They bring you the latest, up-to-the-minute developments that can be applied to your problem.

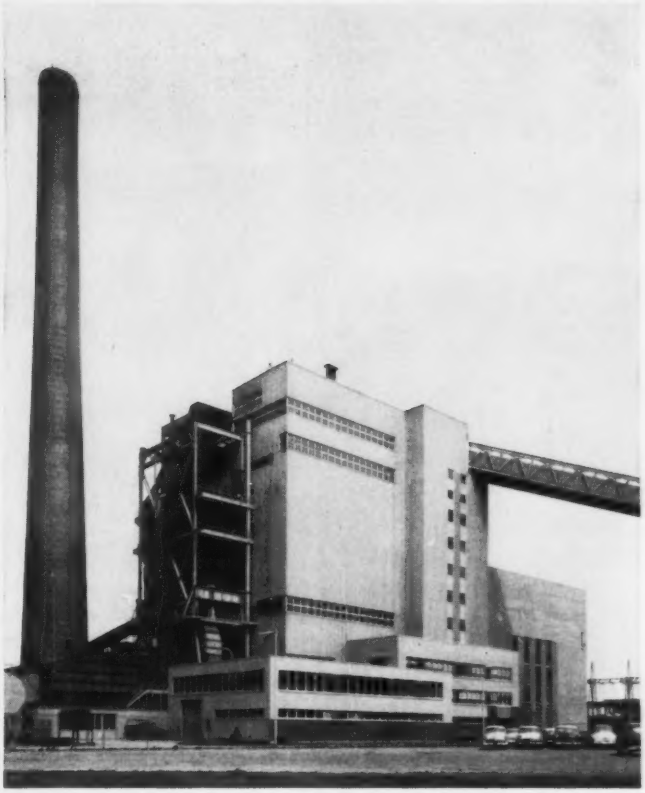
2. Complete Line of Equipment

Bailey manufactures a complete line of standard, compatible pneumatic and electric metering and control equipment that has proved itself. Thousands of successful installations, involving problems in measurement, combustion and automatic control, are your assurance of the best possible system. You can be sure a Bailey Engineer will offer you the right combination of equipment.

3. Sales and Service Convenient to You

There's a Bailey District Office or Resident Engineer close to you (listed under Bailey Meter Co. in your phone book). Phone for expert engineering counsel.





Bailey Controls for combustion, feed water and steam temperature at the Bay Shore Station of The Toledo Edison Company. The FPC reported a 1957 heat rate at Bay Shore of 9,210 Btu per kwhr, making it one of the 15 most efficient plants in the United States.

depend on Bailey Meters and Controls

✻ 15 MOST EFFICIENT PLANTS 1957 Heat Rates Reported by the Federal Power Commission

	Btu/kwhr	Meters	Comb. Control	Feed Water Control	Supht. Control
1. Kanawha River (Appalachian Electric Power Co.)	9,118	B	B	B	B
2. Muskingum River (The Ohio Power Co.)	9,139	B	B	B	B
3. River Rouge (The Detroit Edison Co.)	9,140	—	—	—	—
4. Clifty Creek (Indiana-Kentucky Electric Co.)	9,147	B	B	B	B
5. Tanners Creek (Indiana and Michigan Electric Co.)	9,180	B	B	B	B
6. Kyger Creek (The Ohio Valley Electric Corp.)	9,201	B	—	B	B
7. St. Clair (The Detroit Edison Co.)	9,210	B	B	B	B
8. Bay Shore (The Toledo Edison Co.)	9,210	B	B	B	B
9. G. G. Allen (Duke Power Co.)	9,349	B	B	B	B
10. John Sevier (Tennessee Valley Authority)	9,350	—	—	—	—
11. Phillip Sporn (Central Operating Co.)	9,370	B	B	B	B
12. Milliken (New York State Electric and Gas Co.)	9,371	B	—	B	—
13. Shawville (Pennsylvania Electric Co.)	9,396	B	—	—	B
14. El Segundo (Southern California Edison Co.)	9,467	B	B	B	B
15. Colbert (Tennessee Valley Authority)	9,490	B	B	B	B

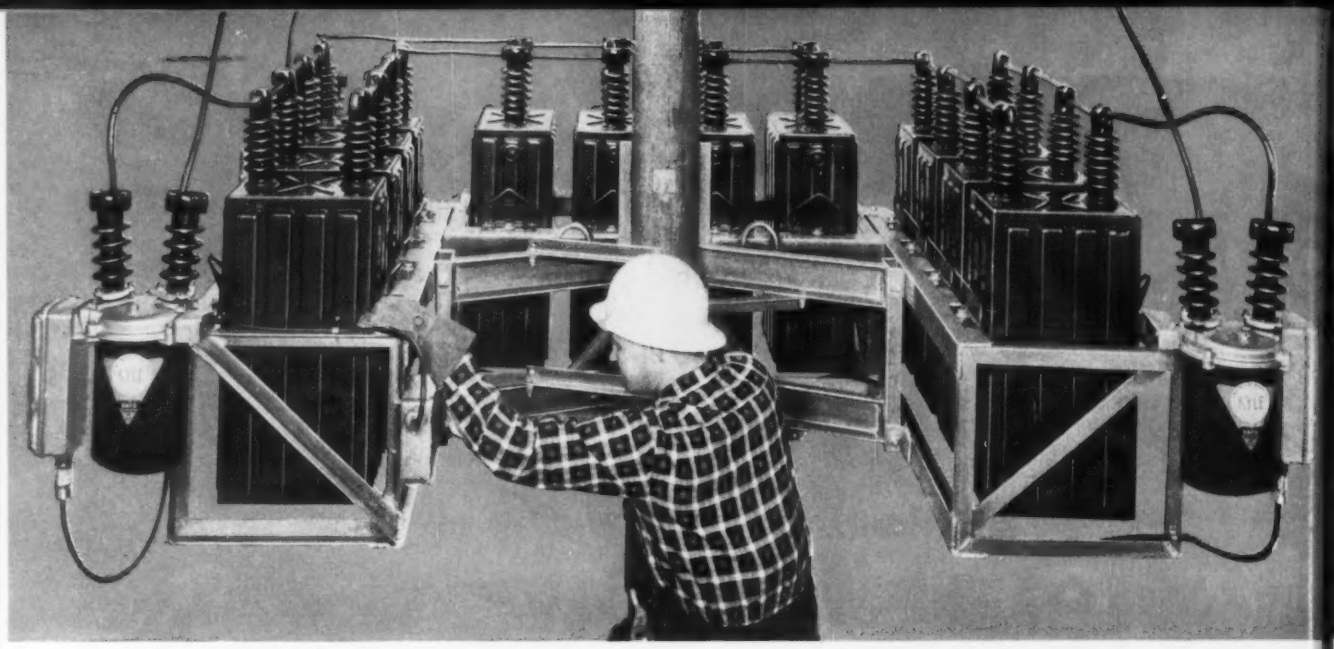
A141-2

Instruments and controls for power and process

BAILEY METER COMPANY

1060 IVANHOE ROAD • CLEVELAND 10, OHIO

In Canada—Bailey Meter Company Limited, Montreal



CLUSTER-TYPE POLE-MOUNTED RACK, pre-wired, with switches, ready to install. Available in 600, 900, and 1200 kvar. Three frames are bolted to the pole mounting bracket and to each other. These racks may be hoisted in three sections, or may be bolted together on the ground and hoisted as a complete unit.

Here's L-M's Outstanding New Line of 100 kvar Capacitors, Equipments

L-M announces a revolutionary new 100 kvar stainless-steel Elemex capacitor which is smaller, lighter, more compact because of transformer-type cooling; a complete new line of corrosion-proof aluminum-alloy hangers, racks, blocks.

by **N. K. DELANEY,** Product Manager
Capacitors and Regulators
Line Material Industries

All 100 kvar capacitors announced to date present the utility man with a problem of excessive size and weight. To overcome this problem, Line Matérial research engineers have developed a revolutionary new capacitor design.

Cool . . . Cool . . . Cool!

In this new L-M 100 kvar capacitor, transformer-type liquid circulation makes possible a very substantial weight and size reduction, and keeps hot-spot temperatures even lower than in L-M's (or others') 50 kvars! The design provides cooling ducts in sides and ends of the tank. Elemex Liquid circulates freely up between the packs and down the sides, keeping temperatures low. Tanks are stainless steel with heat-radiating paint finish.

NEMA-Standard 15⅝" Mounting

The new Elemex is the only 100 kvar that meets NEMA-standard mounting dimension of 15⅝ inches—the same as 50 kvar and smaller units! This makes it possible to replace two 50's with one 100 kvar—*in the present rack*.

Full Line of Hangers, Racks, Blocks

A complete line of hangers, racks, and blocks has been specially designed for these 100 kvar units. All are light, strong, corrosion-proof aluminum alloy.

The line includes the following:

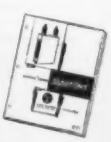
- single-unit hangers (100 kvar).
- 3-unit hangers (300 kvar).
- single-row pole-mounted racks for 300, 600, and 900 kvar.
- cluster-type racks for 600, 900, and 1200 kvar.
- block frames with ratings from 600 to 2000 kvar in 200 kvar increments.
- elevating structures

JUST LOOK AT THESE FIGURES!

Brand	Over-all Height	Tank Width	Tank Thickness	Mounting Dimension	Weight 2400 V 100 kvar
L-M	32 7/16"	13½"	9⅛"	15⅝"	185 lbs.*
Co. B	33⅛"	20"	7½"	22⅝"	270 lbs.
Co. C	33½"	25"	5½"	27⅛"	260 lbs.

**15% less per kvar than L-M's own 50 kvar.*

NEED WE SAY MORE?



Why Wait? Act Now! Discuss this new L-M 100 kvar Elemex Capacitor with your associates. Get in touch with the L-M Field Engineer right away—or wire or phone Line Material Industries, Milwaukee 1, Wisconsin, to reserve the supply you will need.

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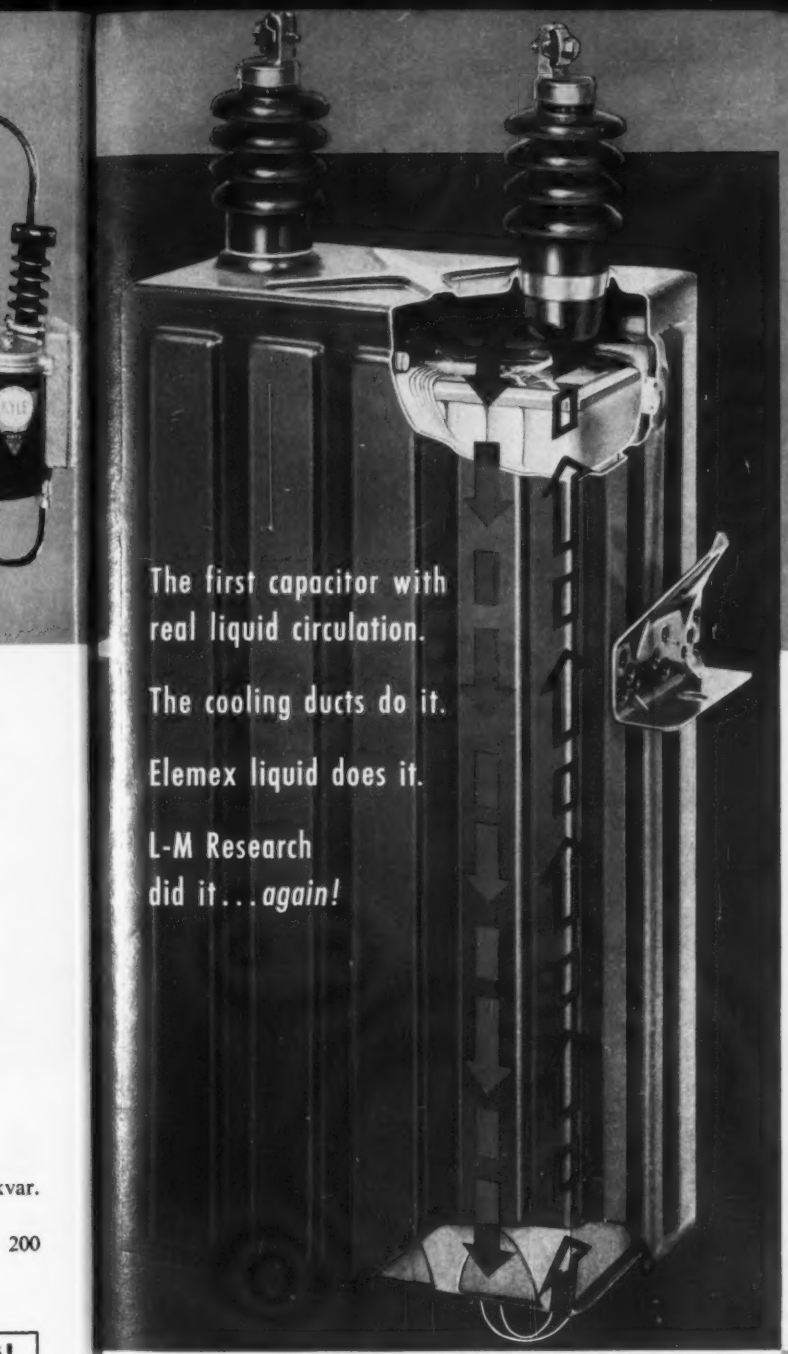
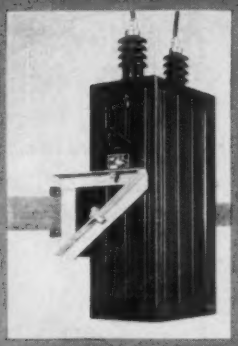
LINE MATERIAL® Industries

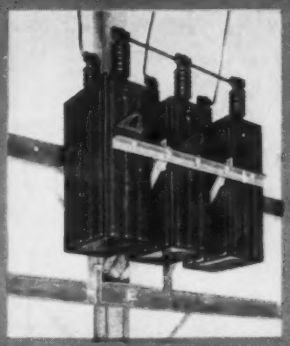
McGRAW-EDISON COMPANY

DISTRIBUTION TRANSFORMERS • KYLE RECLOSERS AND OIL SWITCHES • FUSE CUTOUTS AND FUSE LINKS • LIGHTNING ARRESTERS • POWER SWITCHING EQUIPMENT
PACKAGED SUBSTATIONS • CAPACITORS • REGULATORS • OUTDOOR LIGHTING • LINE CONSTRUCTION MATERIALS • PORCELAIN INSULATORS • FIBRE PIPE AND CONDUIT

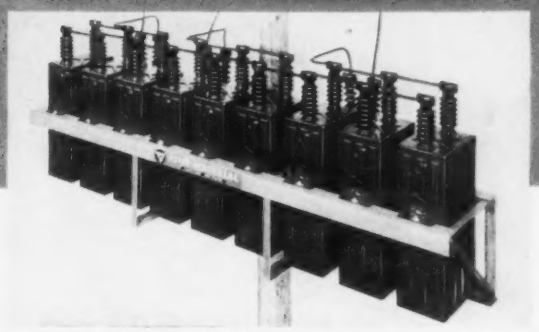




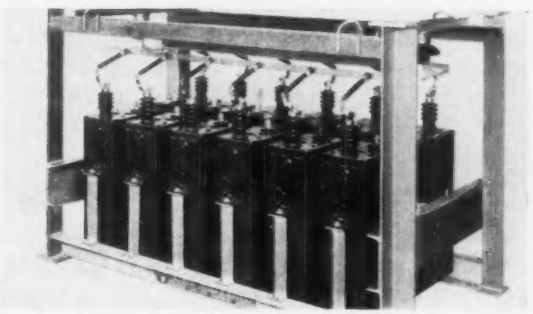
SINGLE-UNIT CROSSARM HANGER.



THREE-UNIT HANGER. All have ground clamp for either aluminum or copper conductor.



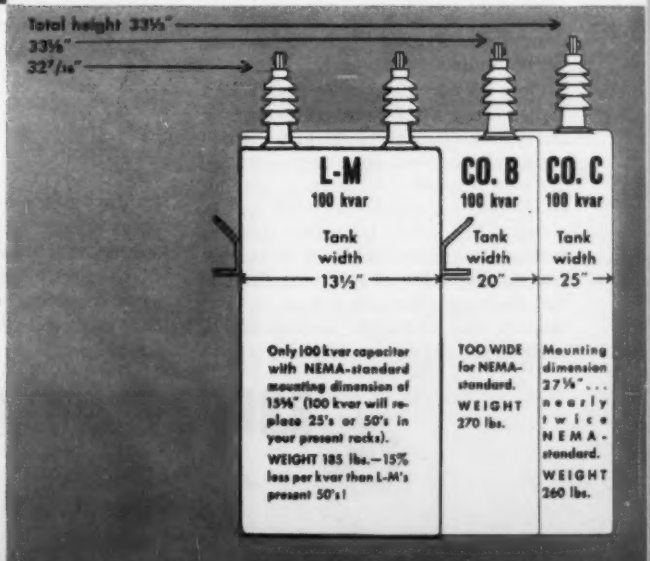
SINGLE-ROW pole-mounted racks are available for 3, 6, and 9 units—300, 600, and 900 kvar. All these racks are of welded construction. Galvanized steel pole bands (instead of using through-bolts) are an optional accessory.



BLOCK FRAMES are of all-welded construction, jig-assembled for accurate alignment. Ratings are 600 to 2000 kvar in 200 kvar increments. Fuses have 4000-amp. interrupting capacity each. Space saving averages about 25%, in comparison with blocks of 50 kvar units.

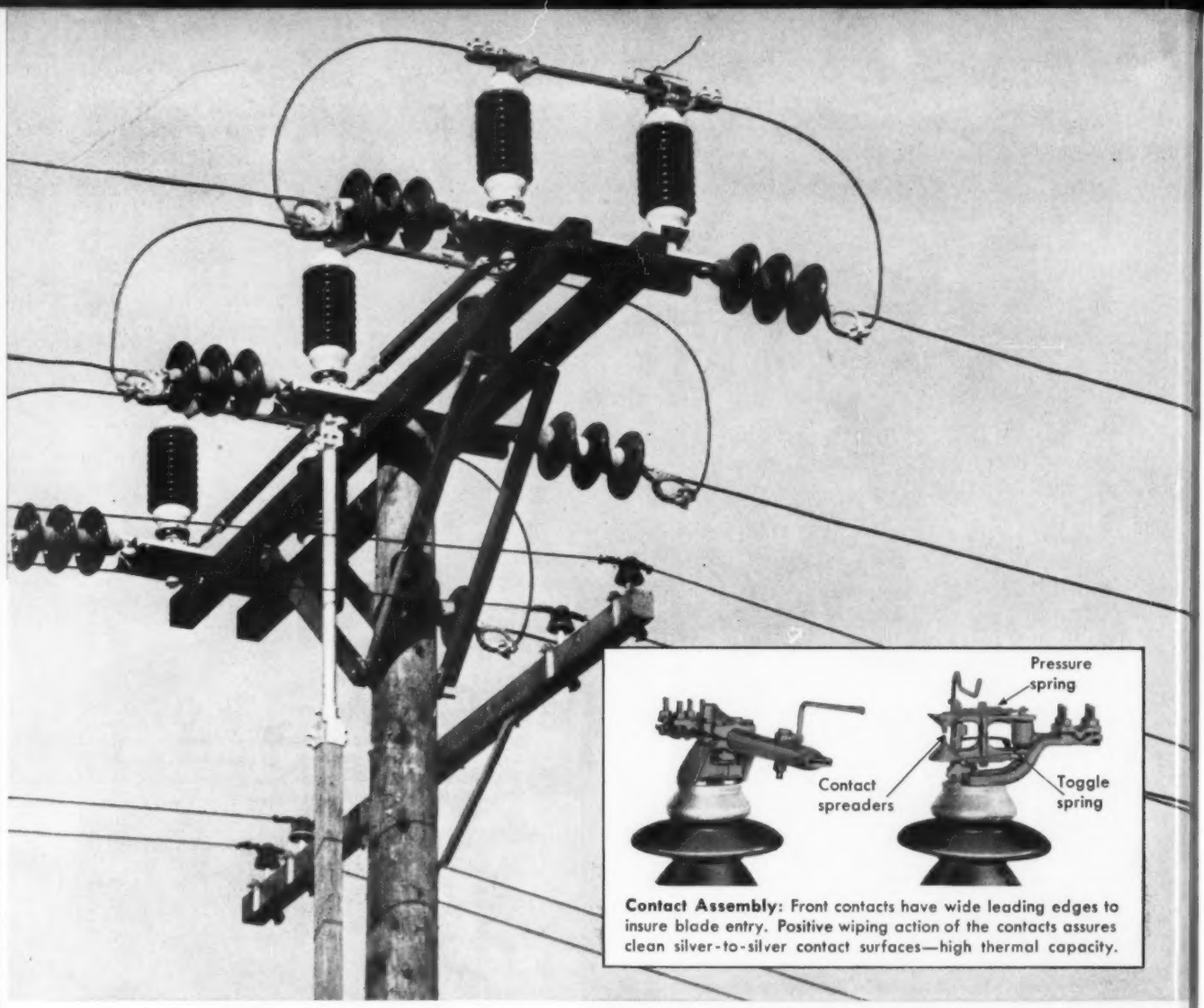
THE HOT-SPOT TEMPERATURE of L-M's new 100 kvar is even lower than that of 50 kvars, because of this new transformer-type liquid cooling. The Elemex Liquid rises between and around the packs, then goes down through the ducts and is cooled. The packs are cooler, because the heat comes out!

DIAGRAM shows how compact the new L-M Elemex capacitor is. Note also the weights. The lighter weight and narrower tank reduce bending moment on the pole, make capacitors and racks easier for linemen to handle and hoist.


Total height 33½"
33⅛"
32⅞"
L-M
100 kvar
Tank width 13½"
Only 100 kvar capacitor with NEMA-standard mounting dimension of 13⅝" (100 kvar will replace 25's or 50's in your present racks).
WEIGHT 185 lbs.—15% less per kvar than L-M's present 50's!
CO. B
100 kvar
Tank width 20"
TOO WIDE for NEMA-standard.
WEIGHT 270 lbs.
CO. C
100 kvar
Tank width 25"
Mounting dimension 27⅛"... nearly twice NEMA-standard.
WEIGHT 260 lbs.

Elemex Capacitors

McGRAW-EDISON



Contact Assembly: Front contacts have wide leading edges to insure blade entry. Positive wiping action of the contacts assures clean silver-to-silver contact surfaces—high thermal capacity.

L-M's New Side-Break Switch Is Rugged, Reliable and Easy To Operate

Line Material has designed a new, rugged side-break switch which has all the desirable operating features of a dependable switch for both line and substation sectionalizing.

Only six current transfer points with high-pressure silver-to-silver contacts and heavy back-up mass provide high thermal capacity for continuous or short-time fault currents. Straight-line current path minimizes short circuit forces tending to open switch. Minimum frictional drag at rotating terminal is achieved by current transfer on center of rotation. Rugged full-floating contacts swivel to give smooth, easy operation, positive wiping motion, and definite ice-breaking action.

Positive Toggle Action

Wide-angle leading edges on front contacts insure blade entry regardless of alignment, with no loss of contact pressure. Contact-positioning spring has positive toggle action to hold the contacts in the open position (45° from switch centerline) or firmly in the closed position. Ease of operation and long contact life result, because contact spreaders preload pressure springs for minimum contact movement during blade entry. Wide-spaced contact jaws and clearance around moving parts facilitate positive switch action under severe ice or corrosion conditions.

Silicone-Lubricated for Life

All bearings and moving joints on the switch are silicone-greased—lubricated for life, and positively sealed with silicone cord rings. Water, dust or dirt cannot enter to affect bearing operation.

Get Complete Information

L-M's new side-break switch is available in 600 amperes, 7.5 to 69 kv as a single-pole, or up to a six-pole unit. Ask your L-M Field Engineer for information and bulletins on L-M's Power Switching Equipment. Or write Line Material Industries, Milwaukee 1, Wisconsin.

McGRAW EDISON

LINE MATERIAL Industries

McGRAW-EDISON COMPANY

Power Switching Equipment

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Editorial Comment

JUNE 22, 1959

Nuclear Costs Are Backed by Firm Data

Major reactor designers promise "economically competitive" nuclear power plants in actual operation within ten years. Some estimates indicate the first competitive stations could be on line by 1965.

For some years the utility industry and the general public have been hearing amateurish forecasts that competitive nuclear energy would arrive "within a decade." Central station atom power, in quantity, would be a reality today if some of these predictions had been accurate.

Prior to this year, there has been only one realistic claim for a competitive plant. Even that was a special case, an installation in an isolated, high fuel cost area under particular conditions.

What is the difference between the latest estimates, and those of the past, which so often proved unrealistic? Why should we have any greater confidence in the latest predictions?

The reason is simple: The fresh claims are backed, as never before, by actual field data.

Operating prototype plants, stations in actual construction, and numerous research and development projects recently have been pouring forth quantities of data.

Task forces composed of reactor system designers and power plant engineers have fed this information into systematic studies of various reactor types. They have produced overall power cost estimates permitting easy comparison with conventional plants. They have recommended the sequences and timing of development, design and construction to achieve the selected target power production cost at the target date.

Several of these studies are reported in this issue (see p 63). In general, of course, the various articles do not agree on target costs or dates. However, the conclusions given are mutually comparable.

Target costs given are realistic, ranging from just over 6 to about 8.4 mills per kwhr. This spread would show "competition" in most regions of the U.S.

We think the studies are well done, and that they merit the serious consideration of the electric utility industry.

Stricter Rules for the Regulators

The Federal Power Commission is considering a change in rules which would more clearly define "proper communications" between the commission and parties in any formal regulatory matter pending before the commission.

Under the proposed rule change, any written communication bearing on the merits of a formal proceeding would be made public. Any oral ex parte communication to any of the five commissioners or the hearing examiner would be forbidden. The change would not forbid either written or oral communications with the staff—such as takes place in preliminary conferences on hydroelectric licenses or other matters.

It seems to us that such a rule may be helpful in clarifying the relations between commissioners and interested parties. FPC has invited comments on the proposed change before June 30.

Bigger Battle Looms on Imports

OCDM turns down U. S. firms' arguments for curbs, lays groundwork for a bitter fight for a growing domestic market

When the White House last week rejected domestic heavy electrical equipment makers' plea for new import restrictions on foreign competition, in effect it gave the go-ahead to an increasingly bitter battle between U. S. and European producers for a small but growing domestic market.

Key to the intensity of the struggle—both economically and politically—is the importance manufacturers on either side of the Atlantic place on U. S. electrical energy output five to ten years hence, not the relatively limited demand that exists for hydraulic turbines, turbo-generators, transformers and circuit breakers today.

It was on these four specific types of equipment that Director of Civil and Defense Mobilization Leo A. Hoegh turned down domestic industry requests for import curbs based on their essentiality to the nation's defense programs or "national security."

U. S. producers, led by General Electric Co, Westinghouse Electric Corp and the National Assn of Electrical Manufacturers, will now take their case to Congress.

Two Chances for Change

On Capitol Hill, where sentiment for increasing trade protection of domestic industry has been mounting steadily, electrical equipment makers hope for two chances at reversing the effects of the unfavorable OCDM decision. One is a move by Rep John H. Dent (D-Pa.) to put more teeth in the Buy-American Act, which provides for government purchases of U. S.-made products except in instances where foreign competitors' prices fall below a prescribed price differential.

Under existing law, the White House has set that differential at 6%, or 12% if the domestic bidder is in a depressed area, or unlimited if national security is involved. Dent's amendment would require a wider base-price differential, based in each individual case on the spread between fixed costs of manufacture, including differences in wage rates, production costs, even taxes and social security liabilities. (At one time the Buy-American clause carried a 25% differential.)

The Dent amendment has been put on the agenda of the House Public Works Committee for hearings sometime this summer. But because it involves a trade law, the traditionally more liberal trade-minded House Ways & Means Committee may request jurisdiction.

HOEGH: 'Deleterious effects'

The second hope domestic electrical equipment manufacturers have pinned on Congress is for tighter legislative controls on White House trade agreement procedures, which could be written into the books only as an amendment to the basic Reciprocal Trade Agreements Act.

This latter effort is a longer shot. In passing a four-year extension of the reciprocal trade law last summer, Congress voted down similar amendments. Instead, it met demands for increased trade protection by broadening the law's Section 8—the national security provision under which the electrical equipment industry was rebuffed.

Domestic producers this week were re-hashing the OCDM decision for possible hints of future administration policy. There were a few hopeful signs. In ruling on the hydraulic equipment covered by industry's original petition in March, 1958, OCDM Director Hoegh specifically reminded the producers that he still is considering a subsequent petition covering steam turbines and generators.

Conceivably, that decision could go the other way. Although a smaller segment of the industry than the hydraulic equipment makers, it is more sensitive to increasing foreign competition. Also, makers of this equipment rely heavily on the huge machine tool category known as "elephant tools," which Hoegh specifically cited as "important to the nation's mobilization base," in his ruling on hydraulic equipment. It was to avoid the possible dismantling of elephant tools that Hoegh last winter gave as his reason for awarding Baldwin-Lima-Hamilton an Army Engineers' hydraulic turbine contract at Greer's Ferry, Ark., under the Buy-American Act.

Defense Essentiality Upheld

One concession the electrical equipment industry won in the OCDM Section 8 ruling on hydraulic equipment last week was the agency's support of its contention of defense essentiality. The manufacturers' petition for import protection cited this as the sole basis for relief, admitting that the present level of foreign sales in the U. S. is not currently injuring or threatening economic injury to the domestic industry.

Hoegh said in his ruling: "We accepted the general premise the petitioners advanced. . . . It follows, therefore, that the domestic heavy electrical power producing equipment industry is properly to be considered as essential to the national security." But Hoegh went on to find that the national security has been neither impaired nor threatened by imports.

Of the 3,200-odd power stations in the U. S., 800 are essential to national security, the decision held. Of 102 stations that have installed

foreign heavy electrical equipment, only 35 are essential, Hoegh found.

In the particular case of hydraulic turbine imports, OCDM held out another slim hope of future action. Hoegh recommended that the President "provide for the review from time to time of the extent to which there is a dependence by the U. S. on foreign hydraulic turbines in order to determine whether any alteration in present policy would be necessary in the interests of national security." He also promised to "maintain a continuing study" of this category of imports at OCDM.

Hoegh Backs Servicing Point

The petitioners got one further concession in the decision. Hoegh ruled that their argument for import restrictions on grounds of better quality and easier repair and maintenance "certainly" showed no threat to national security. But he did promise to take steps "to see that federal departments and agencies procuring heavy electric power producing equipment consider including in their invitations to bid a provision requiring bidders to provide on the North American continent, by ownership, lease or other contractual arrangement, repair and maintenance facilities adequate to service the equipment specified."

This means that domestic producers will have OCDM support in their argument in future cases under the Buy-American Act on this point.

Curbs Would Hurt Trade Policy

But the tenor of the entire decision, apart from the above concessions, left no doubt as to how Hoegh based his ruling. In addition to finding that imports are not threatening national security, Hoegh ruled that new restrictions would cause "deleterious effects" on U. S. foreign trade policy, which "would themselves be inimical to the national security."

He said that the curbs would damage U. S. cooperative efforts with its allies.

The foreign policy implications —pushed by State Dept. and Presidential Adviser Clarence Randall— are what finally swung the decision, after Hoegh delayed more than a year reaching a conclusion.

AEC Drafts Ten-Year Blueprint

Agency's vigorous step will aim for weeding out less promising reactor concepts, based on comparative evaluations

The Atomic Energy Commission is drawing up a blueprint for nuclear power reactor development over the next ten years. The object: To weed out less promising reactor concepts so more effort can be concentrated on ones having the best chance of competing with conventional plants.

The plan was disclosed by Ulysses M. Staebler, senior assistant director of AEC's reactor development division, in a speech before the American Nuclear Society.

The AEC official recalled that, in the "early days" when little was known about any concept, "we considered that no concept which offered reasonable promise should be overlooked."

Accordingly, the AEC or its national laboratories did analysis and preliminary development work on more than 100 different reactor ideas. About a dozen are still in research or development stages.

However, Staebler says "the time has come when we can be more selective in deciding which reactor concepts to carry forward . . . It is no longer sufficient to argue that a new concept looks as promising as others under development. It must offer the prospect of meeting an objective sooner, better or more cheaply."

This means that major commission effort recently has gone into design studies and task force analyses aimed at making comparative evaluations of the various concepts. The development of a ten-year blueprint is the newest and boldest move in this direction.

Staebler said the comprehensive plan for civilian power reactor development is aimed at:

- Delineating the specific technical objectives for each reactor concept being investigated.
- Evaluating the economic potential of each reactor type, taking into consideration the time schedule and total cost required to reach maturity.
- Outlining a chronological development program for each reactor concept, including basic research, fuel cycle development, plant construction and operation.

TVA Opens Bids on Big Steam Units

TVA opened bids last week from two domestic and three foreign manufacturers on the largest aggregate of steam turbine-generator apparatus ever bid on. Only a few units are expected to be bought.

Contract bidding was for units of 500 Mw, 400 Mw, 350 Mw, and 275 Mw. Westinghouse also submitted an open bid on an 800 Mw unit, the largest ever offered; and General Electric submitted an open bid on one of 600 Mw.

The unevaluated bids were:

800 Mw—Westinghouse: $24 million. ($30 per kw).

600 Mw—General Electric: $18,007,280 ($30 per kw).

500 Mw—Brown Boveri: $8.5 million ($17 per kw). Parsons: $11,541,000. English Electric: $11,840,000.

400 Mw—General Electric: $12,008,880 ($30 per kw).

350 Mw—Brown Boveri: $6,520,000 ($18.63 per kw). Westinghouse: $11.9 million.

275 Mw—Brown Boveri: $5,530,000 ($20.11 per kw). Parsons: $6,264,000. English Electric: $6,480,000. Westinghouse: $9.3 million.

Allis-Chalmers declined to bid.

Domestic firms submitted bids subject to escalation and took exception to liquidated damages; foreign companies submitted firm bids and agreed to liquidated damages.

All bids will be evaluated for efficiency. In comparing bids, 20% of the total evaluated bid price will be added to each bid proposing manufacture at points outside the U. S.

State Commissions Trim Rate Hike Requests

Michigan halves Consumers Power bid; New York's net rate base hits Central Hudson, debacle follows Con Ed changes

Accelerated depreciation entered the rate-making picture again in two recent developments in Michigan and New York. Meanwhile, in New York City, a small wave of opposition followed Consolidated Edison Co's 25¢ increase in minimum bills and authority to end conjunctional billing.

The Michigan Public Service Commission allowed an increase of $6,788,000 vs $15,300,000 requested by Consumers Power Co. Instead of using a fair value rate base, which Consumers said was $650 million, the PSC allowed $516 million as net original cost. The tax deferral reserve, however, was not deducted from this.

Use of original cost was based on a 1924 Michigan Supreme Court decision (Smyth vs Ames, 169 U. S. 466) which dealt with factors of determining fair value. "The Smyth vs Ames case would appear to support the company's contention . . ." the PSC said. "However, the holding in this case having been modified by a subsequent decision in the case of Federal Power Commission vs Hope Natural Gas Co (1944), 320 U. S. 591, we are compelled to the rule in the latter case in our determination of 'fair value'. . ."

Hope Case Controls Issue

Consumers Power argued that its rates at the time of filing were so low as to amount to confiscation or deprivation of property. The PSC said this placed even more reliance on the Hope case findings, which stated U. S. Supreme Court decisions are controlling on the confiscation issue.

This ". . . binds us to the end result doctrine in determining and properly considering fair value under the claim of confiscation," the PSC held.

A 6% rate of return was set by the commission, which gave ". . . due consideration to the fact that a portion of Consumers' financial requirements have been, and are being, met through the use of funds retained by virtue of taking advantage of accelerated depreciation for income tax purposes."

Central Hudson Gas & Electric Corp was granted a $300,000 a year increase in electric rates as compared with $1,720,000 sought. New York Public Service Commission used a net rate base and allowed a 6.3 to 6.4% rate of return. The commission used actual taxes for both Sections 167 and 168. Proportions of sharing the tax deferrals should favor the customer "in major part," the PSC said.

Robert Wagner's eleventh-hour challenge to two rate changes authorized for Consolidated Edison received a good play in the papers. The Mayor asked the PSC to suspend the hike until after a public hearing had been held. Commission rejected this, saying the public would be heard during a pending investigation of Con Ed's rate structure.

In separate cases the PSC voted to approve an end to conjunctional billing—a 50-year-old practice permitting owners of buildings to be billed at single-meter rates—and authorized a 25¢ rise in the $1 minimum for 2,788,000 customers in New York and Westchester. The halt in conjunctional billing will up Con Ed's revenues by $2.5 million a year and the increased minimum charge would add $8.4 million.

SoCalEd Orders 2 Control Computers

The interest in automatic control of steam plants received a boost with a Southern California Edison Co order for a pair of digital control computers for its Huntington Beach station late last month. Two Model 312 General Electric Co computers will be installed for plant Units 3 and 4, which are now under construction. The computer system will cost $¾-$1 million, GE said.

The computer installation is described as the largest of its kind planned by an electric utility. In addition to automatic scanning, alarm and data logging functions, the computers will execute the following programs: Cold start-up; hot start-up; normal shut-down; emergency shut-down; and control during normal operation.

The new turbine generators are cross-compound units each rated 210 Mw, 2400 psi, 1050F/1000F. Boilers are universal-pressure type rated 1,638,000 lb per hr, using gas and oil fuel alternately.

Among benefits expected from computer operation are increased safety for personnel and equipment, improved continuity of service, and reduction in fuel, operating and maintenance costs. So CalEdison believes continuous surveillance by automatic equipment will reduce the probability of a serious equipment accident. Cost of a major accident to a 200-Mw unit has been estimated between $1½ and $2 million.

Automatic supervisory control system also should reduce the number of unit outages and initiate prompt corrective action during emergencies. In cases of unavoidable outage, there will be a faster and safer return to service.

Continual monitoring of plant performance and more precise control will allow a potential saving in plant efficiency and better use of manpower required to operate the stations, the utility said. With better control over thermal stresses during start-up and shut-down a reduction in maintenance costs is expected.

Each computer will continuously scan 900 input points and actuate upwards of 250 contact outputs per sec in addition to logging some 50 critical points hourly and identifying alarm point information. Input points will be scanned at 1,000 points per sec.

Earlier this year, Louisiana Power & Light Co announced plans for a $750,000 computer system for a 225-Mw single-unit station. (EW, March 23, p 55) Daystrom Systems, a division of Daystrom, Inc, is designing and building the system.

A Slight Snag at Stinson

Extra time to perfect the "Charles-Town About" control system and slowness in procuring fibreglass bodies have delayed production of the first modern electric cars at Stinson Aircraft Tool & Engineering Co. Delivery of the first model to Atlantic City Electric Co will be made by July 1, Stinson says.

New Charge for Trucks

Ohio Power Co, enthused about the load potential of electrically-propelled vehicles, has arranged for a June 23 demonstration of four Cleveland Vehicle Co truck models at Canton. The utility has invited bakery, milk, newspaper, and other fleet-owning firms to attend the event, which takes place at a local fair grounds.

Meanwhile, Electric Storage Battery Co placed its new Exide-Ironclad on display at the Cleveland Material Handling Exposition. Present improvements have increased life of the battery and boosted power output by 45% in the last three years, ESB declares.

King Takes EEI Office

On June 11, Allen S. King, Northern States Power Co president, was installed as Edison Electric Institute president for 1959-60. He succeeds Jack E. Corette, head of Montana Power Co. Also installed as EEI vice president was Sherman R. Knapp, president of Connecticut Light & Power Co.

An 'Owling Success

Bothered by pigeons? Do what army engineers do—get an owl.

Since McNary Dam on the Columbia River went into operation in 1953, its line towers, crane booms, and spillway gate recesses have become a haven for thousands of homeless pigeons. Until recently, the pigeons had chuckled at the efforts to dispossess them.

Last month, however, the engineers placed life-size papier-mache owls at strategic points along the dam. The phony birds hang from suspension hooks in their heads. At the slightest vibration, they swing and emit a throaty purr, such as might come from a hungry owl. And, their eyes glow in the dark.

Frightened pigeons have been heading for the hills wherever the owls have been used.

Bonneville to Hold the Line

Bonneville Power Administration will hold its 2-mill-per-kwhr rate for the next five years—in the face of a fiscal 1959 deficit and predicted larger deficits in the next few years —according to Interior Secretary Fred Seaton. BPA's renewed $17.50-per-kw-year charge (2 mills/kwhr at 100% load factor) must gain FPC approval.

Care Urged on Reclamation

Fund requirements for the Reclamation Bureau in the next two years will run high above average because of seven new construction starts approved by the House. This warning came from Interior Undersecretary Elmer Bennett, who told the Senate Appropriations Committee the bureau's construction needs might reach nearly $300 million in fiscal 1961-62. By comparison, $21 million is proposed for fiscal 1960 and the average for the past 12 years has been $189 million.

He urged careful consideration of future fund requirements so that projects now being built will not be slowed down because of new starts. He also asked that funds for Pleasant Valley site studies and Bonneville Power Administration construction, both of which the House turned down, be restored. A wheeling contract proposed by an Iowa power company led to his recommendation that a House-approved transmission line project costing $800,000 be eliminated.

Controversy in Kalamazoo

Can a power company buy a municipal system, including an outdated plant, then charge off the plant's value as a business expense? Consumers Power Co, purchaser of the Kalamazoo city utility, believes the answer is yes. It is seeking a circuit court reversal of a Michigan Public Service Commission decision that $900,000 of the plant's $1,030,000 worth should fall in the surplus account. The state's Municipal Utilities Assn sides with the PSC. The association's newsletter says: "If this (write off) was permitted it would be possible for a company to pay outrageous prices for municipal utilities, and then charge the rate payers for much of the cost." The municipal group plans to intervene.

Windscale Damage Set

The Oct. 10, 1957 runaway of a Windscale plutonium-producing reactor caused about $5.6-million damage, the British government has estimated. Much of the loss came from precautionary disposal of milk.

Realignment on Research

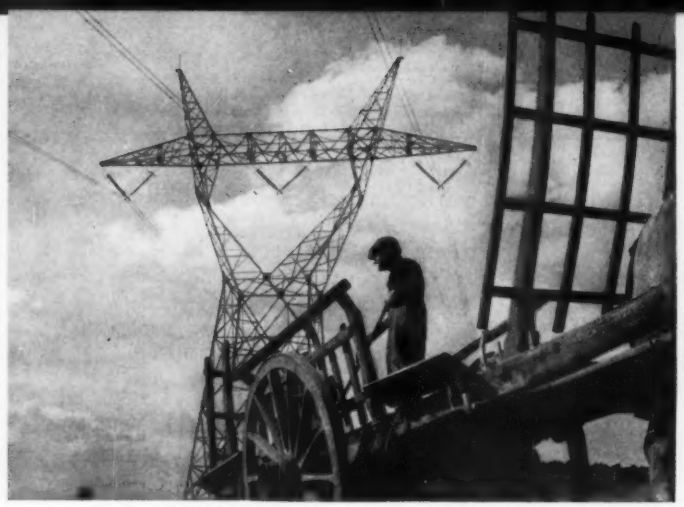
Pacific Power & Light Co has organized a research department to manage technical and scientific investigations PP&L has under way.

Regrouping of personnel now working on electric-industry technology, power supply, fish conservation, and raw materials testifies to the growing significance of organized research programs, says Pres Paul B. McKee. PP&L's research will be better handled if apart from day-to-day engineering problems, he adds.

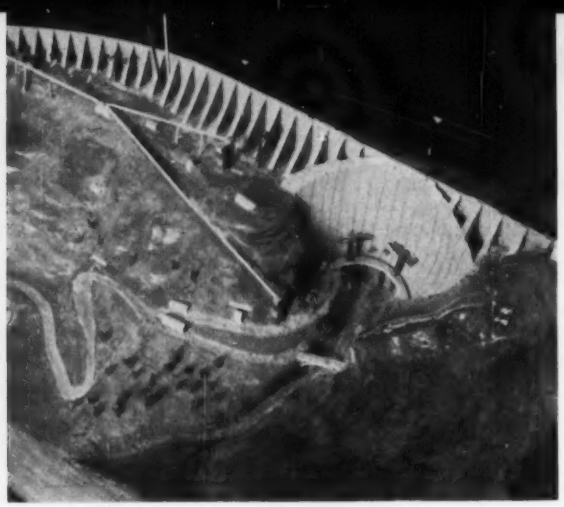
Among activities drawn together by the shift are investigations of fresh water sources in sand dunes, coal deposit investigations, and fish conservation. Other likely fields: safety, generation, transmission and new consumer products including electric vehicles.

GPU Forms Nuclear Firm

Saxton Nuclear Experimental Corp is the name of the new firm under whose auspices will fall atomic matters of General Public Utilities Corp. Organized on a stock share basis, with the 20,000 shares subscribed for by GPU's domestic subsidiaries, Saxton will build a 5,000-kw plant.



CHANGEOVER from 225 to 380 kv on Alps-Paris line took only two months, upped line capacity from 350 to 550 Mw



LARGEST DAM will produce 496 Mw. Model of Roselend shows how two contiguous dams will close off basin for lake

Integrated Network, Daring Hydro

Conversion to 380-kv transmission provides link between plants in Alps and load centers. EDF, the state-owned utility, faces financial problems in keeping up with load

ARTHUR ERICKSON, Chief, McGraw-Hill's Paris News Bureau

Since 1946, the power industry of France has paced a dynamic growth for the country's economy. The progress is exemplified by magnificient dams in the Alps, an extra-high-voltage transmission line linking them to Paris, a nuclear "castle" rising in the Loire Valley near Chinon, and some interesting distribution ideas. Difficult days, however, may be in the offiing in keeping up with a consumption that doubles about every ten years.

Electricite de France, the state-owned utility formed in 1946, is the agency that must meet the challenge. Last year EDF produced approximately 60% of the nation's output of 62,200-million kwhr. The rest was generated by other nationalized industries, notably the railway system, the coal authority and Compagnie Nationale du Rhone, which was set up before the war to exploit the Rhone River's hydraulic potential. Total generating capacity was 17,000 Mw at the end of 1958.

Power sales for EDF amounted to nearly $800 million in 1958. With the income it must pay operating costs, taxes, interest and amortization on its loans. In 1957, after two deficit years, EDF showed an operating surplus of $10.7 million.

Difficult days may lie ahead, however, because government approval is required for EDF's equipment programs. With nearly all sectors of the economy pressing for funds, the government cut EDF's equipment loans to low levels in 1957 and 1958. This year, $560 million has been authorized. This is less than EDF wanted, but some relief has been gained by a "green tariff," which makes off-peak usage advantageous. The peak shaving, EDF says, is worth $119 million of new plant.

Power shortage in sight? Not in the next few years, based on EDF's performance. It will have power for continued industrial expansion.

One of EDF's first steps after acquiring the some 2,000 small and large utility companies was a program of hydro-plant construction. The "white coal" of the Alps, the Masif Central and the Pyrenees was a source of power that would help alleviate a chronic energy deficit.

As a result hydro capacity has more than doubled production; last year totalled 32,200-million kwhr, most of it from EDF plants.

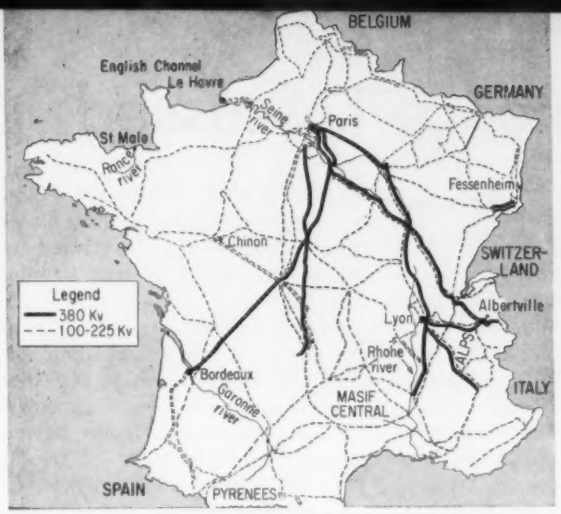
Nowhere is the Gallic touch more evident that in the dams of France. An evolution from classic heavy-gravity dams to light-gravity and arch dams has inspired daring designs. Some lean downstream, others have ski jump spillways, and one—an arch dam only 8-ft thick at the base—is the world's thinnest.

An outstanding example of the evolution is Roselend, which will be France's largest dam, now building at Beaufortain in the Alps. Two contiguous dams of completely different types will close off a basin to form a vast artificial lake. One dam, an arch structure 492-ft high with a 755-ft span, plugs a deep, narrow gorge. Buttressed wings on either side of the arch extend along the rock spurs flanking the gorge. The crest is 2,500 ft long.

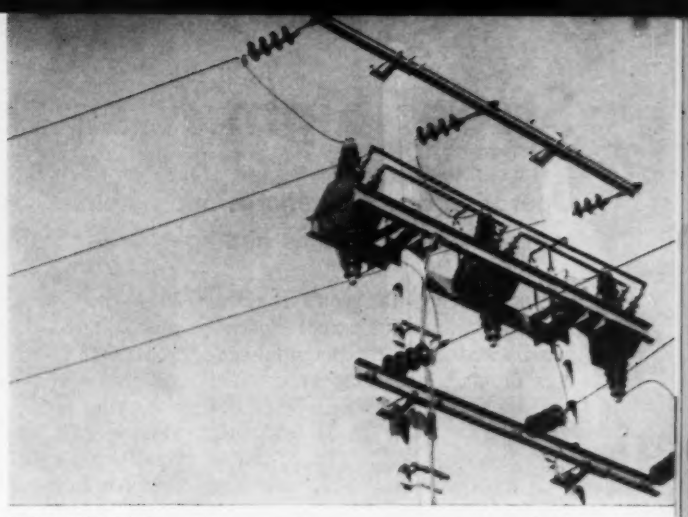
Roselend to Produce 496 Mw

Associated with Roselend will be an underground powerplant with 496-Mw capacity. A network of tunnels will feed the turbines. The head will be 3,700 ft. When it goes on the line at the end of 1961, the project will pour 700-million kwhr annually into the French grid.

Although dwarfed by Alpine dams such as Roseland, little Argentat dam in the Masif Central ranks high on the list of interesting hydro projects. At Argentat, EDF is testing prototypes of low-head units developed for the tidal plant



NETWORK, existing and planned, also will include 380-kv links with neighboring countries, 220-kv dc tie with England



VACUUM-CAST or prestressed concrete poles are standard, ease lack of poles. Switch to 220/380 v is under way

Designs Help French Meet Demands

near St. Malo. The first group, with 90-million kwhr potential, was installed in 1957.

Called "groupes-bulbes," the units look like torpedoes. They lie horizontally in the penstock with both the turbine and generator immersed. Compact and light, they weigh about a fourth as much as conventional equipment, kw for kw. Their design makes it possible to exploit low-head sites on rivers as well as tidal estuaries. The units cut down the size and cost of power houses and—especially important for tidal stations—operate in reverse as pumps.

The group installed at Argentat has the torpedo-like turbine downstream and the generator behind it in a secondary housing. Water flowing past the generator cools it; heat transfer to the housing walls is improved by operating the generator in an oil bath. A second type has the turbine upstream.

Forty of the turbine-upstream type will one day turn the 34-ft tides of the Rance River estuary into 800-million kwhr a year. The bulbs will be planted in a 2,400-ft-long hollow dike with a lock at one end. They will be grouped in blocks of ten with a transformer for each block. Specifications include 9-Mw capacity and 5.65-kv operating voltage for generators, a 90-Mw 5.65/225-kv rating for four transformers, and 26 x 25-ft sections for flow gates.

In lab tests, EDF determined the most efficient cycle for the plant is to run the turbines—after establishing required head—on both rise and fall of the tide.

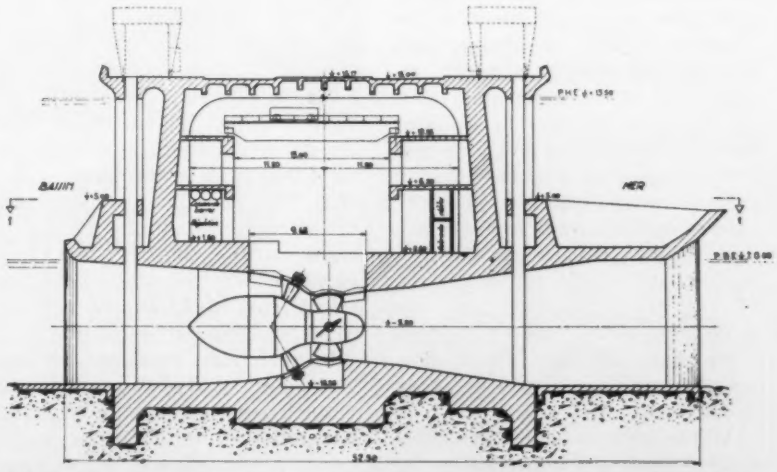
Canal Taps 350-Ft Head

Large, conventional hydro plants play a big role in the capacity build-up. The Grand Alsation Canal, a development on the Rhine, is a good example. Providing both navigation and power, its eight lock-dam-plant combinations—linked by ten-mi canals—will convert the 350-ft head between Bale, Switzerland and Strasbourg, France into 6-billion kwhr a year. One of the newest dams at Fessenheim has four vertical units, each with a 21-ft-dia Kaplan turbine and a 45-ft-dia generator of 45,000-kva capacity. Annual output for the plant averages 940-million kwhr. It took 3,000 men three years to complete the construction of the project.

Hydro capacity in France now totals some 9,100 kw, enough to supply 52% of 1958 national demand.

By 1954, the hydro program established an adequate balance with thermal output. Since then, emphasis has been on steam plants, many

(*Continued on page* 130)



TORPEDO-LIKE "bulb group" at Rance River estuary tidal plant combines turbine, generator in dike. Units are reversible, pump up head in off-peak periods

Street Light Maintenance Discussed

Operating cost, procedures and potential savings of group-replacement programs highlight street lighting conference

Experience with group replacement programs for street lighting was backed up by the potential savings of such programs at a street lighting maintenance conference sponsored by Mitchell Maintenance Co, Muncie, Ind. The 2½-day meeting drew over 25 attendees representing about 16 electric utilities, manufacturers, and lighting consultants. Solutions to specific operating problems, such as glassware breakage and failure of cutouts, also were covered in detail.

Operating costs and procedures for a group-replacement program were detailed by Lawrence Renas, Dayton Power & Light Co. For 1958, group replacement covering 12,060 lamps represented a total cost, including all overheads, of $59,927, or $4.96 per lamp, charged to operations, and $35,088, or $2.91 per lamp, charged to maintenance. This program, begun in 1950, calls for replacement of 2,000-hr lamps every six months, and fluorescents every two years. For most efficient replacement, lamps are replaced at 70% of rated life, which approaches 5-7% burnout of lamps in the group.

Potentiality of a planned group replacement program was presented by J. C. Strasbourger and M. E. Mitchell of the sponsor company. Upwards of $3 per fixture per year can be saved through group replacement over spot replacement under "average worst" conditions, said Strasbourger. Using a series incandescent 10,000-lamp street lighting system as an example, he listed these estimated major dollar savings: Fewer lamp replacements, $26,000; reduced glass breakage, $8,000; constant-current transformer operation, $3,900; less cutout failures, $3,800; and proper use of buffers, $2,000. These savings are not cumulative, he emphasized, because every street lighting system does not have the same average worst conditions.

Mitchell compared group vs spot replacement for a utility having 12 patrolmen for 73,000 incandescent and 3,000 mercury-vapor lamps. With group replacement, lamps replaced annually would drop from about 243,000 to 170,000 and only six patrolmen would be required.

During 1958, said Frank Wones, Dayton P&L, cost of making about 8,000 spot calls on the Dayton system for burnouts between replacements was $1.82 per lamp, including labor and its overhead. Other utilities reported these spot-call costs: Detroit Edison, $10 per trip, including lamp, wages, and all overheads for a 2-man crew in a radio truck; Wisconsin Public Service, $6-7 per replacement, including labor and transportation; Carolina Power & Light, $1.65 per lamp for labor only; and Potomac Electric Power, $1.50 per lamp on system plus $0.50 for replaced lamp.

Look for Trends on Circuits

Renas said it requires careful and continuous training to keep group and spot replacement crews on the alert for trouble and trends on lighting systems. In detailing the program in the Dayton District, Wones said one man patrols the 800-unit mercury vapor lamp system downtown plus two other streets every night. District serviceman makes up a spot-replacement route from reports of the patrolman, police, and the public. A senior clerk consolidates daily reports and analyzes monthly compilations against one, two, and three years ago to determine trends on each circuit.

On the Dayton system, lamps are controlled by photoelectric cell either individually or in groups. Of the 4,000 cells in the Dayton district, 246 were field-adjusted and 367 changed out during 1957. Of 7,000 on the entire system, 919 were shop-repaired during 1958, for a total cost of $3.40 per cell, or $0.54 per lamp on the system.

Interest was expressed in the "throwaway" cadmium-sulphide cell photoelectric unit, which if found inoperative is returned for credit toward a new unit with a 2-yr guarantee.

Field studies and laboratory tests were cited by Line Material Co in its study of cracking of dirty glassware. Breakage may be caused by the thermal shock of rain striking hot glassware.

Thermal-shock breakage, a smooth crack with no chipping or local cracking, generally is found in glassware with long, deep bowls and in fixtures with lamps having ratings of 6,000 lumens or higher. Whether glassware breaks depends on operating temperature as determined by degree of uncleanliness, mechanical mounting stresses, design of prism roots, and type of glass.

Laboratory tests have related uncleanliness and the "safe" wattage size for different types of glassware under which breakage is 1% or less. For example, clean glassware on an incandescent fixture that will operate safely at 400 w can be operated safely only at 200 w with a 50% reduction in light transmission (partially dirty), and only at 100 w for zero transmission (totally dirty).

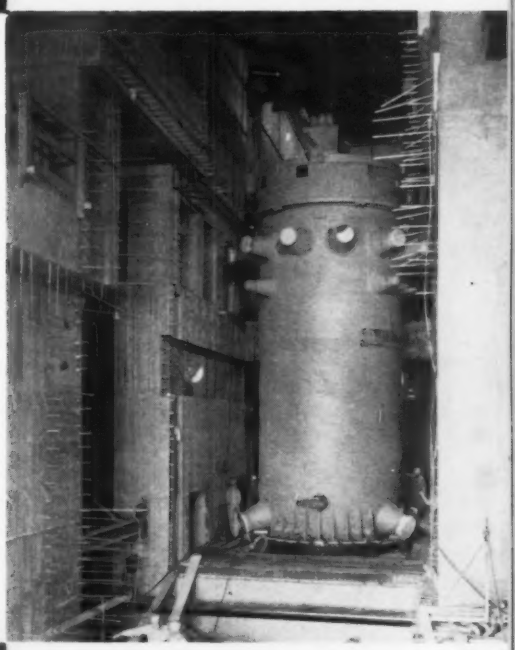
The conference aired the problem of defective film disk cutouts for series street lighting. It was pointed out that defective units are characterized by a misalignment of the "button" inside the cutout and may be found by visual inspection. Renas said Dayton P&L doesn't replace cutouts when the lamp is replaced, unless a new lamp substituted for a non-burning lamp shows the cutout to be defective. Mitchell suggested that cutouts not be changed if the filament of the associated lamp is unbroken. G. K. Harrington, Mitchell Maintenance, recommended that cutouts at periodic locations be opened and inspected for indications of lightning strokes or primary contacts.

Characteristics of cutouts of different makes should be considered when using disk cutouts with series lamps having an integral cutout on the filament support, cautioned Mitchell. These characteristics can increase the percent of non-burning lamps due to cutouts that failed. Wones of Dayton P&L suggested that manufacturers of cutouts develop and publish comparison performance data for their cutouts and various makes of lamps.

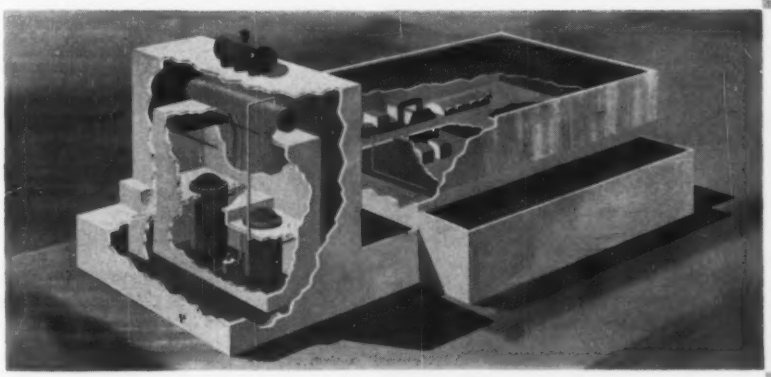
4th Annual Nuclear Power Report

A Special Report:
Charles Hochgesang
Assistant to the Editor

FIVE power reactors continue to operate, feed data to designers



EIGHT, totalling 704 eMw, are under active construction



SEVEN are in serious planning. Meanwhile, costs, timetables firm

A few short years ago, nuclear power began shedding its aura of scientific mystery. Each succeeding year has brought new, more incisive definition of its basic engineering concepts. The past twelve months has proved especially fruitful.

This year, prolific data from operating plants flowed into the hands of nuclear designers. As a result, each basic reactor type having experimental backing underwent a knowledge refinement permiting a new clarity of forward vision.

In its Fourth Annual Nuclear Power Report, Electrical World thus is able to present fresh evaluations in terms of costs and timing for three of the major reactor types. A fourth article bears on the significant new subject of nuclear superheat.

And EW again tabulates pertinent data on power reactors operating, building, and in serious planning.

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Organic Cooled Reactor Design

Study of 300-eMw plant affirms concept's potentiality for producing power at 7 to 8 mills/kwhr; spurs development

RALPH BALENT, Deputy Director, Organic Reactors, Atomics International Division, North American Aviation, Inc., Canoga Park, Calif.

The recent AEC-sponsored Organic Cooled Reactor Design study of a 300-eMw plant indicated that the plant would produce power in the 7 to 8 mill per kwhr range and affirmed the potential of this concept for producing economical nuclear power.

A six-year development program, including an additional Organic Test Reactor plus a prototype reactor, is recommended. The program will lead to 300-Mw plant power costs of 8.1 mills per kwhr by 1965. A purely commercial 450-eMw organic plant could be initiated in 1962 for operation by 1966 and capable of 6.1 mills per kwhr by 1969.

Organic materials as possible reactor coolants and/or moderators were suggested 15 years ago by Fermi. For some years it was felt radiation decomposition rates would be excessive. But by 1953, considerable data indicated the polyphenyl class of organics offered superior resistance to high temperature and high-level ionizing radiation.

Diphenyl, Santowax O-M and Santowax R have physical and nuclear properties conducive to reactor coolant/moderator application. Early studies showed organic cooled and moderated power reactors would have these attractive features:

1. Low primary system pressure for temperature in the 600 to 800F range.

2. Compact core.

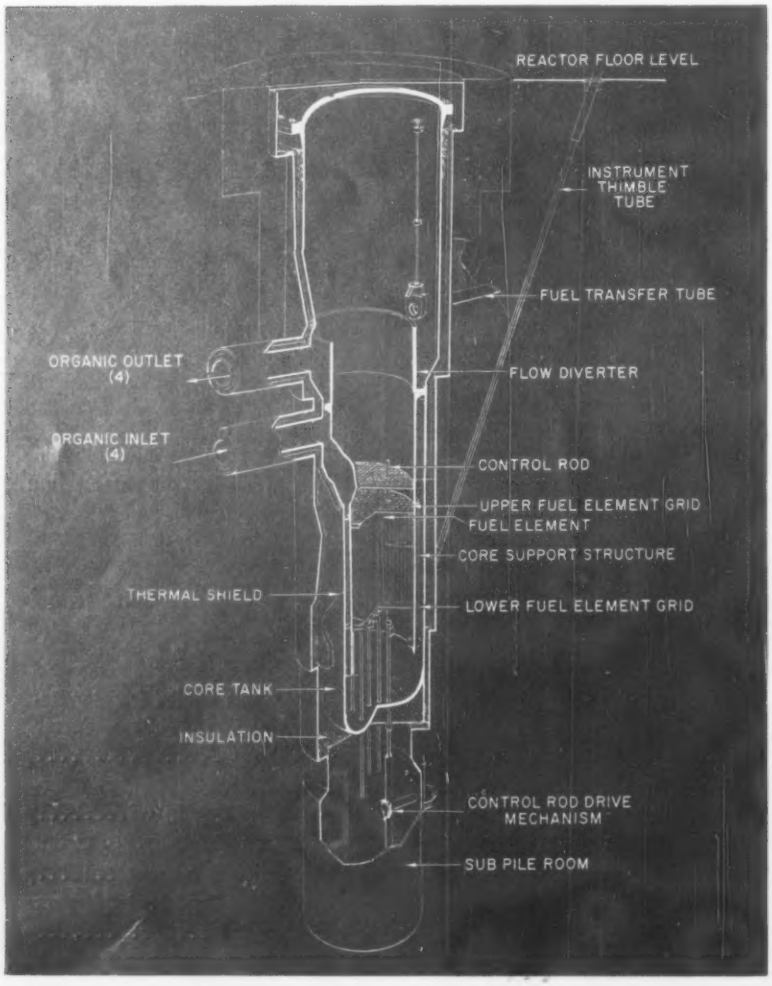
3. No hazardous chemical reactions with coolant, uranium, fuel or water.

4. Negligible corrosion rates.

5. Standard construction materials and components (aluminum for fuel cladding and low carbon steels in standard pipes, valves, and "hot oil" pumps are suitable).

6. Low induced activity in coolant.

7. Fluid moderator-coolant gives large negative temperature coefficient of reactivity.



FOUR HEAT TRANSFER LOOPS carry organic coolant from 300-eMw reactor. Early studies showed organic cooled reactors have attractive features

Fouling Is Negligible

Thus it appeared an organic moderated and cooled reactor could be of simple design, relatively inexpensive to construct, and inherently safe. Yet certain limitations were recognized. Organics slowly decompose at operating temperature and under nuclear irradiation, so that a purification system and makeup supply is required. Heat transfer is relatively low, compared with water and liquid metals, so that a high surface-to-volume fuel element design is needed.

A reactor experiment, OMRE, was authorized by the AEC in 1955 to determine the technical feasibility of the organic reactor concept. It was designed, constructed, and started by Atomics International at the National Reactor Testing Station in Idaho. By Jan. 1, 1959, this non-generating unit had over 22 million thermal kwhr.

OMRE operation showed negligible fouling of the heat transfer surface. Applying OMRE radiation damage rates to suitable power re-

Can Produce Power Cheaply

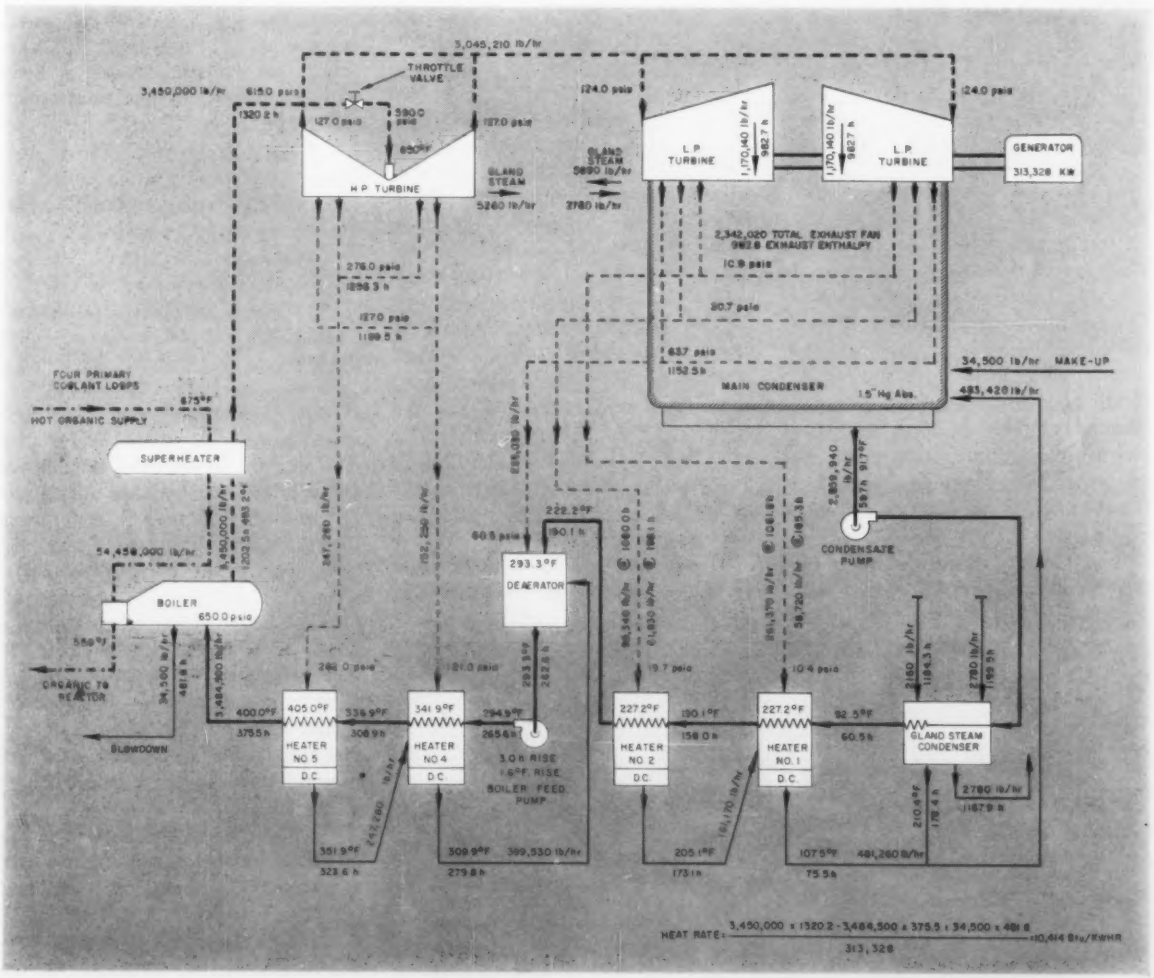
actor designs, which use organic for both coolant and moderator, showed a makeup cost in the range of 0.6 to 0.7 mills per kwhr.

A recent study by Bechtel Corp and Atomics International on the AEC-sponsored Organic Cooled Reactor Study indicated the concept's outstanding potential for producing economical nuclear power soon in large central-station power plants. A summary description of a 300-eMw Organic Moderated and Cooled Reactor (OMCR) plant, developed during the study, illustrates the low-power-cost potential. Design is based on technology consistent with July 1960 construction start and a three-year construction schedule.

The reactor has a design capability of 1,013 Mw of heat, providing a 5% design margin over the turbine's guaranteed steam flow capacity, and is cooled by Santowax-R having a bulk temperature of 675F at the reactor outlets. The design load coolant flow is 54,450,000 lb per hr with a 550F reactor inlet.

Nucleate boiling (subcooled nucleate boiling), the principal heat transfer mechanism, is accomplished by setting the primary system operating pressure so that the saturation temperature at this pressure is below fuel element surface but above coolant bulk temperature. Thus, nucleation will occur on the fuel element surface, but the bubbles collapse as they are swept into the main body of the coolant.

With nucleate boiling, heat flux is independent of coolant velocity and about proportional to the cube of the difference between fuel surface temperature and coolant saturation temperature. Thus, the core can operate at heat fluxes comparable with the fluxes of cores utilizing forced convection, but with reduced coolant velocity. This permits a large coolant temperature rise across the core (125F) with a total flow about half that required in a forced-con-



HEAT BALANCE for the 300-eMw nuclear plant shows 10,414 Btu per kwhr heat rate at 313,328 kw gross electrical generation. Net power to the switchyard is 300 eMw. Plant is designed to function on a load-following basis

vection cooled, close-packed lattice core. Total pumping power is low and system operating pressure only 36 psia.

The active core is about 11 ft dia and 12 ft high, and has 352 fuel elements. Each is made of 100 extended-surface rods of uranium oxide fuel clad and aluminum powder metal (aluminum plus aluminum oxide) inside a 0.035-in. thick stainless steel box.

The uranium is enriched to 2.5% and total core loading is 52,000 kg uranium. Initial excess reactivity (hot and clean) is 12.6%, permitting programmed reloading by zones to get average fuel life of 15,000 MWD/T contained uranium.

Reactor control is by 61 cruciform control rods driven from below the reactor and programmed over the core life to control power and maximize average burnup.

The core is in the lower part of a 2-in. thick reactor vessel 67 ft, 7-in. high with 17 ft max dia. A transfer tube connects reactor tank to fuel handling pool and permits spent fuel to be liquid-cooled at all stages of refueling.

Each Loop in Vault

Four heat transfer loops are in separate vaults around the reactor vessel. Each can be isolated from the system and has a vertical, two-stage, turbine-type circulating pump. Steam generators are horizontal, tubular heat exchangers. The superheater is above the boiler. Each loop has a bypass line around the steam generator for steam generator heat input control at different power levels.

The steam generators have two power-operated relief valves, each capable of relieving about 120% of steam generator design steam flow. Each has ASME Boiler Code safety valves. Primary coolant loops are protected from the excess pressure of a steam generator tube rupture by a series of relief valves on the main coolant lines. At full capacity the steam generation system delivers 3,640,000 lb per hr of steam at 600 psig, 650F to the turbine throttle.

The plant is designed for emergency decay heat removal from the core by convective circulation through any two of the four steam generators. Auxiliary equipment consists of purification, degasification, and gas handling systems. The purification system maintains the high boiler compound (HBC) to a maximum of 30% of the coolant by weight and cleans the new coolant makeup by continuous distillation.

The plant includes a 300-Mw (nameplate) at 3.5-in. Hg, 1,800-rpm, single-shaft double-flow exhaust turbine, coupled to a hydrogen-cooled, 384-Mva, 16.5-kv generator, and a 230-kv transformer. Five stages of regenerative feedwater heating are employed, the center heater a contact deaerator. Feedwater makeup is supplied as steam to the deaerator by waste heat boilers, burning high boiler compound, the product of decomposition in the organic coolant. These units serve also as startup boilers on diesel fuel.

At full loads, the turbine gross cycle heat rate is 10,414 Btu per kwhr at 1.5 in. Hg exhaust. Corresponding full load generation is 313,328 kw gross. Average output of 300 eMw net is delivered to the switchyard.

The plant is designed to function on a load-following basis. Steam pressure ahead of the turbine throttle controls coolant flow bypassing the steam generators, thereby controlling steam generation rate. Bulk temperature of coolant out of the reactor controls reactor power by positioning control rods. Up to 20% of the steam flow to the turbine can be manually bypassed to the condenser during startup.

Due to the low activity induced in the coolant, each steam generator cell is accessible for maintenance shortly after shutdown of the loop, minimizing downtime. Steam portions of the plant are free of contamination.

Costs $231 per Kw

Estimated plant cost through the main transformer is $69 million, $231 per net ekw, including escalation and interest during construction. Present-day cost, excluding escalation but not interest during construction, is $183 per net ekw.

Estimated fuel-cycle cost, at 80% plant capacity factor and steady state operation, is 2.45 mills per kwhr net (22.2¢ per million Btu). These attractive fuel costs are achieved primarily through use of aluminum powder metal (APM) for fuel element cladding, with resultant high neutron economy and low fabrication cost, plus programming of a fuel capable of sustaining high burnup.

Using a 14% annual capital charge plus steady-state fuel and other annual charges, average production cost is about 8.12 mills per kwhr at 80% plant capacity factor.

The AEC is now sponsoring a broad and basic research and development program on organic materials. In addition to heat transfer physical properties, process development and fuels development at Atomics International, AEC is sponsoring studies on coolant development and reclamation of polymerized organics, and tests on organic burnout heat transfer and inpile loops.

With these programs as base, a complete program leading to economically competitive nuclear power is shown in the chart. Indicated are projected programs covering about the next six years. Sequence and emphasis to bring organic reactors into a very competitive commercial market for a large

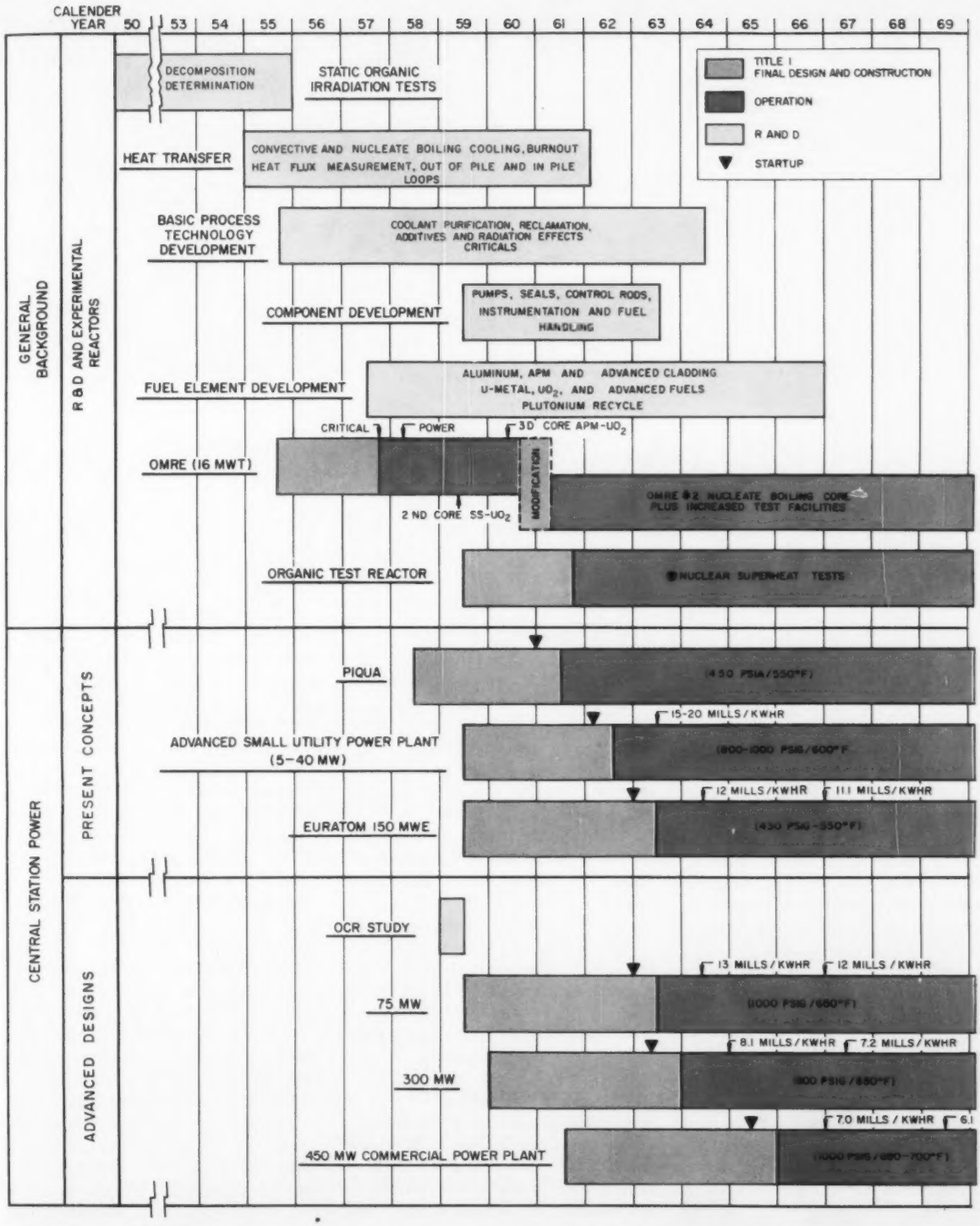
300-Mw OMCR Power Cost

(80% plant factor and 14% capital charges)

	$1,000/year	Mills per kwhr
Fixed charges*	$9,731	4.63
Fuel-cycle cost	5,135	2.45
Organic makeup	1,316	0.63
Operating, maintenance	877	0.41
	$17,059	8.12

At 90% plant capacity factor, power cost would be 7.56 mills per kwhr.

* Includes escalation and interest during construction.



DEVELOPMENT PROGRAM, as recommended, has for its target the production of power at 6.1 mills per kwhr. Such generation is to be achieved by 1969. The program embraces studies of all economic features of the plant

range of plant ratings are illustrated.

A continuing broad program of research and development in heat transfer, coolant properties, and processing techniques is needed to establish basic technology upon which all organic reactors will base. Present programs on forced convection cooling, nucleate boiling, and burnout heat transfer tests need expansion and support for about two more years. Beyond present inpile heat transfer tests, inpile nucleate boiling test loops are needed.

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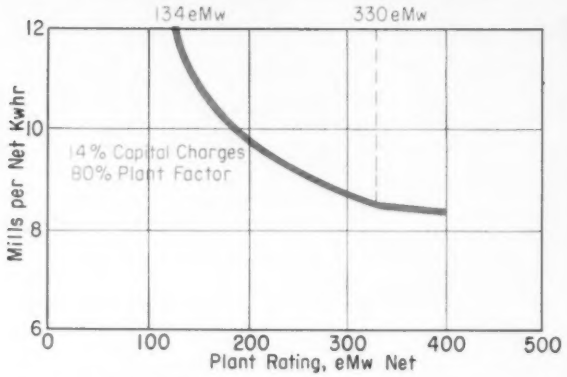

FIG 1—**POWER COSTS** of PWR drop significantly as ratings increase up to about 330-eMw, but not much thereafter

Table I—Design Parameters

	Belgian BR-3	Shippingport*	Yankee YAE	Proposed 330Mw
Thermal Mw	40.9	225	392/482[1]	1140
Electric Mw, gross	11.5	68/100[1]	118/145[1]	360
Steam pressure, psia, drum	520	600	500	680
No. of loops	1½	4	4	3
Valves	None	Double	Single	None
Core Loading				
Kg U	2010	See note[2]	20,000	59,300
Enrichment	4.5–3.4	See note[2]	3.4	2.4 — 3.3
Burn-up, MWD/T	6250	3000	8208	15,000
Primary System psi	2000	2000	2000	2150

* Shippingport Pressurized Water Reactor, a book, Atoms for Peace, Geneva 1958, Addison-Wesley Pub. Co.
[1] Initial/ultimate ratings with present equipment.
[2] 75 Kg highly enriched U; 12,900 Kg natural U

330-eMw PWR Plant Operation

Feasibility and economic study indicates this large plant is a major step toward lower costs

A. R. JONES, Mgr, Application Eng'g Atomic Power Department,

B. L. LLOYD, Sponsor Eng'r, Electric Utility Eng'g Dept, Westinghouse Elec Corp

Westinghouse is now ready to develop, design, and build a 330-eMw (net electrical Mw) nuclear power plant which would be economically competitive with conventional plants in higher-fuel-cost areas of the country. It could be in service by early 1965. This advanced pressurized water plant represents the next logical step in furthering the goal of competitive nuclear power.

An investigation, initiated over a year ago to evaluate technical feasibility and economics of pressurized-water plants in the 200-400 Mw range, concluded that:

FIG 2—**LOOPS** supply 75-million lb/hr water from PWR to 5 steam generators

1. Experience accumulated in design and operation has been so encouraging that it is time for a major step to cut nuclear power costs.

2. The best immediate prospect for sizable cost reduction is construction of very large plants.

3. Pressurized water reactor technology is advanced enough to permit building large plants.

4. Pressurized water plants up to 400 Mw are technically feasible and show substantial power cost reductions.

5. 330 Mw is best plant size.

The first phase of the study established the amount of future technology which could be incorporated realistically into plant designs. The two areas of consideration are plant design and core technology.

Seek Economical Size

Plant improvement areas include: Conceptual design to provide a basis for the best size and evaluation of layout and containment problems; containment; control systems; and components. Other cost reduction areas exist in pressurized water plant technology, and the final design will take advantage of the latest technology. However, cost estimates are based on conservative fact in light of current knowledge rather than optimistic anticipation.

New philosophies and evaluations being developed will be incorporated in the core design. For 1965 delivery, enrichment and other design details can be modified as late as 1963. Considerable fuel technology advances will be achieved in the next 3½ years. Operating experience will be in hand from other pressurized water reactors using slightly enriched uranium fuel in the oxide form. These include the 11.5-Mw Belgian Reactor (BR-3), the 134-Mw (145-Mw gross) Yankee unit, the developmental Saxton plant of General Public Utilities, the Indian Point Plant of Consolidated Edison, APPR-1, and other pressurized water plants.

The extensive fuel cycle development program financed and administered by the AEC will be well advanced and will contribute to this core program. In addition, privately sponsored R & D programs under way today or planned for the near future are aimed at solutions to some of the limiting problems.

For these reasons, reference core design and operating parameters are advanced. These improvements will result in steam pressure increase from 500 psia in Yankee to 680 psia with resulting improvement in the cycle's thermal efficiency.

Design parameters were then established for ten different plant sizes in the 134-to-400-Mw range.

The second phase of the study determined the availability of large major components for such plants. Without exception, all the major components—reactor vessels, steam generators, turbines, pumps, etc.—

Table II—Power Cost Summary

Capital Cost[1]	
Nuclear portion	$44,000,000
Turbine-generator portion	34,000,000
Total plant	$78,000,000
$ per kw net	$ 236
Power Cost (14% capital charge, 80% plant factor)	
Capital	4.7 mills per net kwhr
Fuel	3.0
O & M	0.7
Total	8.4 mills per net kwhr

[1] Includes all capital costs except purchaser's administrative and financial charges such as taxes and interest during construction, land, off-site improvements, escalation, and general and administrative overhead charges.

Table III—Fuel Cost Breakdown*

	Mills/Kwhr	Reduction Through:
Preparation	1.15	Manufacturing technology
Conversion of UF_6 to UO_2		Materials cost
Fabrication of assemblies		Mass production
Losses		Increased burn-up
Recovery of scrap		
Shipping to site		
Use	1.36	Development of low-cost,
Inventory charge on uranium		low cross-section,
Burn-up of uranium		structural materials
Clean-up	0.49	Increased burn-up
Shipping to reprocess center		
Reprocessing		
	3.00	

*Based on time between refuelings. Three such intervals required to achieve total average burn-up of 15,000 MWD/ton.

Likely in '65

can be obtained for plants up to 400-Mw.

Of all the components, the reactor core required the most careful evaluation. But appraisal revealed that the core for plants up to 400 Mw can be built for service in 1965.

Cost Estimates Favorable

Once technical feasibility was established, the third phase of the study evaluated the economics of the various plants. Prices were obtained on all major components. Auxiliary components, installation, and operating and maintenance cost estimates were developed. Preliminary core designs were made from which fuel costs were calculated.

Fig 1 shows the resulting power cost curve plotted as a function of plant rating. Plutonium credit is evaluated at $12 per gram. The capital cost is total plant installed cost, excluding escalation, land, interest during construction, core research and development, and general administrative overhead. Two important conclusions can be drawn:

1. Plants in the 300- to 400-Mw range show very substantial power cost reductions.

2. Increasing plant rating from 330 to 400 Mw offers small additional savings, largely because the 330-Mw plant utilizes the largest available single-shaft, 1800-rpm turbine. The per-kw cost of this turbine-generator unit is particularly attractive.

The 330-Mw plant was selected as the best size for installation today. It is the best compromise between decreased cost obtained from higher plant ratings and increased cost of system reserve to back up larger plants. It is not unduly large, as many utilities will be installing plants about this size by 1965.

The nuclear steam generator, or primary system, for this plant follows the well-defined PWR technology. Approximately 59,000 kg of slightly enriched uranium in the oxide form makes up one core loading. Cladding for the oxide may be either stainless steel or zirconium. Water flows at 75,000,000 lb per hr through the reactor and five loops to five steam generators. This water, under a 2,150-psia average pressure, transfers 1,140 thermal megawatts with a temperature rise of approximately 40F across the reactor vessel. Water entering the reactor vessel will be at 547F.

Each steam generator produces 860,000 lb per hr dry and saturated steam at 680 psi. Auxiliary systems are typical for a pressurized water reactor, but somewhat larger than those now in existence.

The reactor pressure vessel, the most massive component, will require careful review in the light of

(*Continued on page* 81)

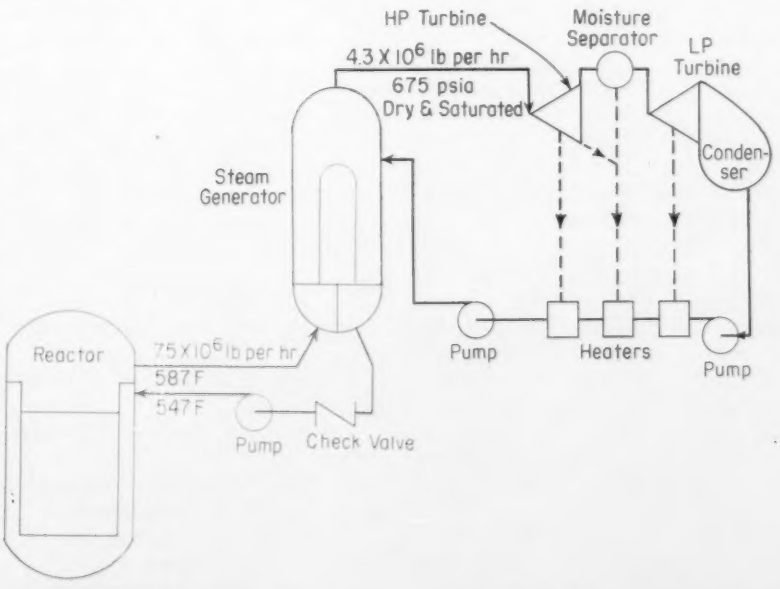

FIG 3—REACTOR gives about a 40F temperature rise to the 2,150-psia water, carrying a total of 1,140 thermal Mw, from 547 entering to 587F leaving

BWR's Economy, Potential Spur

Analysis of experience, potential establishes GE reactor as proved type for competition on design basis by 1965

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D. H. IMHOFF, Mgr, Engineering Development, Atomic Power Equipment Dept, General Electric Co, San Jose, Calif.

Continued intensive development of the boiling water reactor concept can be justified solely on economic grounds. The BWR's economic merit, based on present status and known potential technological gains, are sufficient to spur its development for electric utility service. Belief in the sound economics of nuclear power generation by utilities is General Electric Co's prime inspiration.

Analysis of BWR experience and future prospects concludes:

1. The boiling water reactor's six years' operating experience has established it as a proved reactor type. Its advanced status, compared with other types, is evidenced by its selection in international competition.

2. Nuclear power from any reactor type is not economical today, but the BWR promises to be competitive on a design basis by 1965. Only evolutionary—not revolutionary—development work remains.

3. Further technological advancements must be made. Construction of large present-day-technology plants of any type will not meet the industry's economic objectives. GE believes the best way to make technical gains is through optimum combination of research and development, pilot plants, and large plant construction.

4. To be competitive, any reactor type needs particular, concentrated development. The BWR has progressed to where it merits such attention. The BWR is clearly a contender for immediate commercial development, and a clear-cut development path has been defined to enable its economic fruition.

Advocates of each power reactor type have had faith in its technical and economical future. While economical nuclear power has yet to be generated, operating experience and its solid technological base have fully justified early faith in the BWR. Goals of a few years ago are close at hand. The BWR has a clear-cut and predictable path to competitive utility service.

There are three steps in the evaluation of any undertaking's prospects; future objectives, present status, and what must be done to link the first two.

The utility industry must develop economical nuclear power soon, at minimum additional expenditure. Capital and fuel costs must be reduced, and an optimum balance among cost, time, and risks must be found.

To this end GE has analyzed various alternatives in pursuit of the best solution. The spectrum of possible solutions considered ranged from very conservative combinations involving negligible risks, but excessive cost and time requirements, to "leap-frogging" schemes involving excessive risks and very low cost and time requirements.

The evaluation led to the selection of "Operation Sunrise." This plan for the attainment of economical nuclear power, using boiling water reactors, has been reported elsewhere. By it, GE established the realistic economic goal of having available by 1965 engineering information that will allow designing BWR plants that will generate power competitively in at least 25% of the domestic power market. The target total power generation cost is 6.5 to 7.0 mills per kwhr, based on today's dollars.

Objectives Specified

Specific objectives toward this are:

1. Total plant cost of $175 to 225 per kw.

2. Fuel costs of about 2.0 mills per kwhr.

3. Plant availability comparable to present conventional plants.

There are three reasons for the BWR's advanced status:

1. Its technological foundation is firmly established. Much experimental data, design, construction experience, and operating results from eight BWR's beginning with the Borax and Spert series and proceeding through EBWR, VBWR, and Dresden, have provided a firm technological base for plant and fuel.

2. BWR's completed or under construction have demonstrated the lowest capital cost of proved reactor types. GE has been able to predict construction costs accurately and hold them firm. Dresden is proceeding within original estimates. VBWR was completed under budget. Firm price quotations are being made by GE. Selection of the BWR for the Italian 150-Mw SENN plant is a milestone in its history. It was considered best in economics, design, and development potential after thorough study by an international nuclear expert team in a competitive framework. The merits of low-enrichment oxide fuel are accepted by the industry, and the mass of technology accumulated indicates realistic potential for low-cost fuel.

3. Actual operating experience with small reactors has been most favorable. Initial questions concerning stability, safety, contamination, direct flow of steam from reactor to turbine, direct-contact maintenance, and corrosion have been adequately resolved. The ultimate proof of a large operating BWR will be furnished at Dresden.

Considerable development work remains. Fig 1 illustrates present economics of BWR's compared with conventional power plants. The top curve shows BWR plant cost for a range of large sizes based on present technology, with costs determined by construction of Dresden and SENN-type plants. The bottom curve gives today's capital cost of conventional plants. It is a third quartile curve, with 75% of plants lying below and 25% above. The middle curve was constructed by adding a $50 per kw increment to the lower. This increment is the approximate capitalized value of a 1.0 mill per kwhr projected advantage of nuclear over conventional fuel cost. This potential fuel cost advantage is, of course, the principal reason for widespread interest in nuclear power. The center curve

Development

provides an approximate moving-target capital cost which must be met by nuclear installations if they are to become widespread.

The present capital cost curves are based on domestic conditions, including all capitalization factors. They assume today's dollars and initial units, including site development, land, and interest during construction. The curves are representative of costs of plants which GE would be willing to build today on a firm-price basis.

Significantly, Fig 1 shows that construction of very large units, based on present technology, simply does not meet economic objectives. Further technological advances must be made. Lower curves must be established, similar to the top curve, but based on more advanced technologies. These improvements must be pursued until the curves intercept and fall below the target-cost line.

What is the next step? Where does today's status of the BWR lead?

General Electric chose the boiling water reactor to meet the above economic objectives. This decision was made after thorough evaluation of status and potential of other promising reactor systems. It was based on design, construction and operating experience of the company with other reactor types, including sodium-cooled, pressurized water, gas-cooled and pressurized water tube-type reactors. The boiling water reactor was found to hold the best potential for immediate commercial development. Future efforts will be focused on this system, but limited work will continue on other promising systems.

Fig 2 illustrates how the merit of a reactor system can be assessed by examining three major parameters:

1. Present Status, the first parameter, is shown as Intercept A on the chart. Present status is measured by technology, present cost, and operating experience of the reactor system and its fuel. BWR met these tests. Considering all factors, its present status is superior to all other reactor types, GE believes.

2. Potential, the second major parameter, is the projected perform-

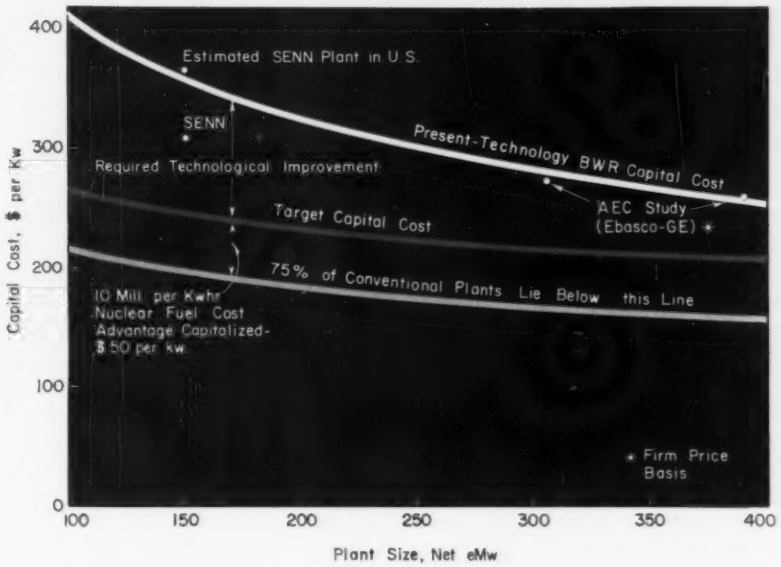

FIG 1—MIDDLE CURVE is the moving cost target which nuclear plants must achieve to become widely accepted for power production in utility systems

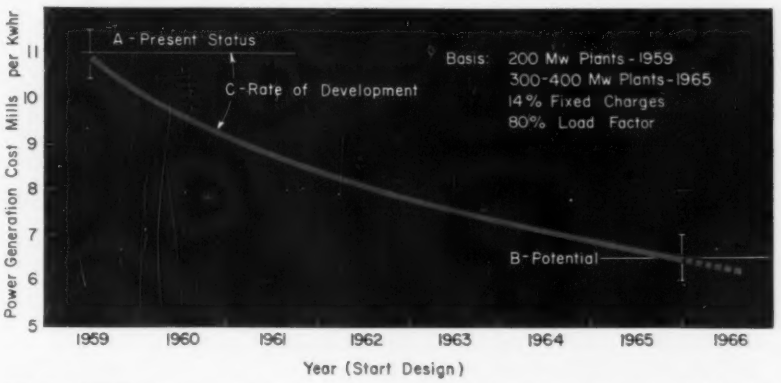

FIG 2—MERIT of any system for the production of power on a commercial basis is assessed by examining present status, potential, and development rate

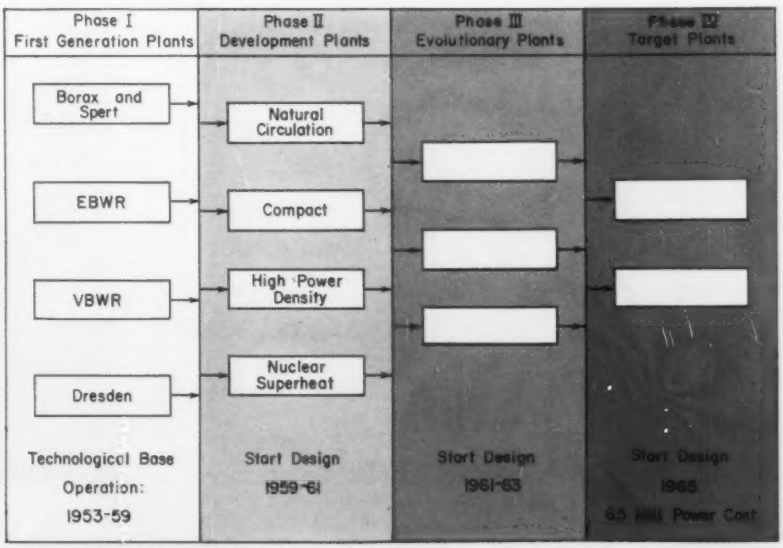

FIG 3—PROPOSED PROGRAM for nuclear plant development purposely avoids definition of evolutionary and target plants

ance of a reactor system. Illustrated as Intercept B, it is estimated to be 6.0 to 7.0 mills per kwhr total power generation cost for the BWR. Potential BWR improvements have been realistically, though conservatively, considered. Its basic simplicity, which enables a more compact overall plant design, its ability to operate at higher power densities, its adaptability to direct addition of nuclear superheat, and other plant refinements are some specific reasons for the BWR's excellent potential.

3. Rate of Development, the third parameter, is shown as angle C of the line connecting A and B. This rate is dependent upon the distance between A and B, which measures the amount of improvement necessary, and the time to make the improvement. In assessing system merit against this parameter, consideration must be given to a clear-cut and predictable course of action which gives a favorable probability that the ultimate potential B can be achieved. For instance, alternate avenues of achieving the ultimate potential are desirable, so as to avoid carrying all technical eggs in one basket and being dependent upon single, critical breakthroughs.

An important factor affecting the trend line slope is the magnitude of the required development cost. For BWR it is estimated at about $128 million, including research and development. From this must be subtracted the value of the generating capacity of the plants, about $40 million, to determine industry net capital outlay of $88 million. This is rather modest, relative to expenditures in the nuclear field to date.

Again, GE has examined many reactor systems and concluded that the BWR rates high in this parameter. GE believes that it has the best chance of becoming competitive at the earliest date, and at the least development expense and risk to the industry. The development work which remains to be done is "evolutionary," not "revolutionary." No scientific breakthroughs are required. For the most part, the required development is the same hard kind that produced modern steam turbines, steam generators, and high-voltage transmission systems.

Costs Must Be Lowered

To meet the economic objectives, appreciable reduction in both present-day fuel and capital cost must be made. The most important factors which will enable the reduction of fuel cost to 2.0 mills per kwhr are: Decreased present fuel fabrication cost, increased exposure lifetime, increased conversion ratios, decreased plant heat rates, and reduced fuel inventory. The future boiling-water-reactor fuel development program concentrates on these.

Capital cost can be reduced by any one or a combination of the following factors: Technological advances, construction of larger units, and larger volume of business.

Construction of larger current-technology plants simply does not meet the industry's long-term needs. Furthermore, a significant nuclear business volume must wait until nuclear power becomes competitive. Major attention must be devoted now to more technological gains.

A careful analysis of the realistic potential improvements in the BWR system will enable GE to meet its economic goal. It has resulted in these specific technical objectives:

1. Increasing core specific power by a factor of about two.

2. Simplifying reactors, systems and supporting services and facilities, resulting in more compact plants.

3. Increasing practical unit sizes to the range of 400 to 500 eMw.

4. Improving steam conditions to those of modern, conventional plants. Increasing thermal efficiency, from 28 to 35%.

5. Improving fuel performance, reducing fabrication costs by at least half, and extending irradiation exposures to 15,000 MWD/T or more.

GE has initiated a development program, specifically designed to attain these technical and economic objectives. It envisions a programmed research and development work, small pilot plants, and large

(*Continued on page* 82)

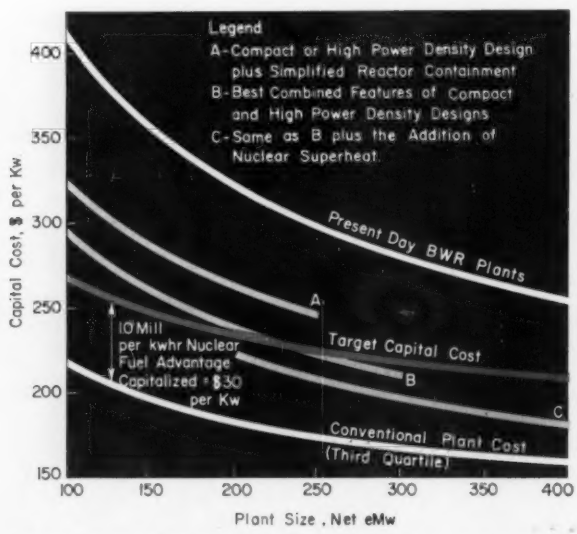

FIG 4—**CURVES** above are forced circulation plants; but others can be drawn for natural circulation plants

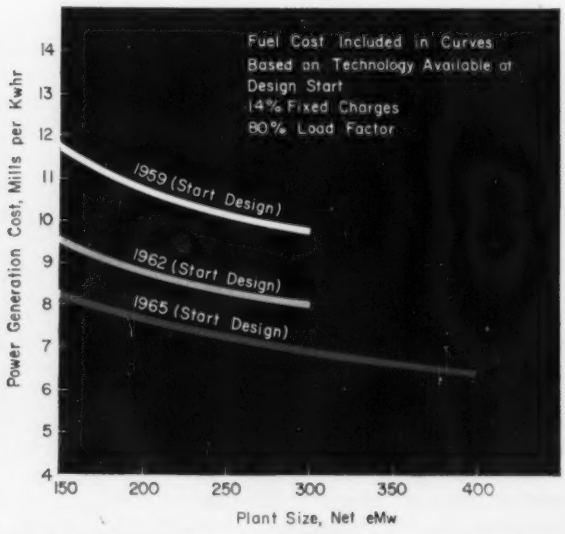

FIG 5—**EXPECTED TOTAL COSTS** of power from BWR are shown in relationship to time and size, based on program

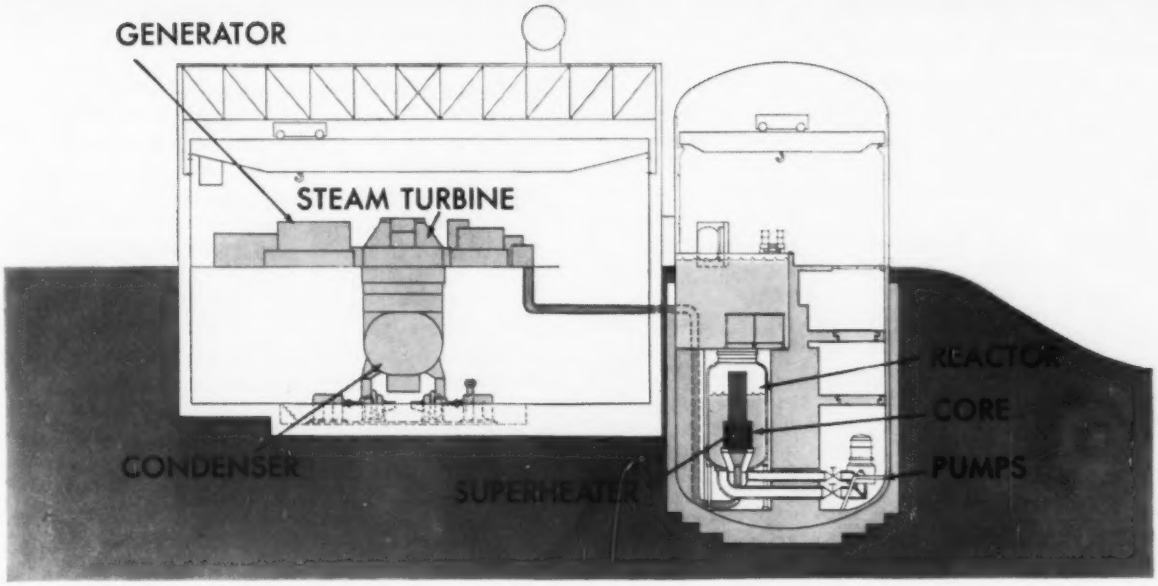

FIG 1—**CONTAINMENT SHELL** will hold reactor and associated equipment, including the nuclear superheater. Controlled recirculation will be another feature, but the turbine-generator will be housed in a conventional building

Nuclear Superheater Augurs New Era

Pathfinder's features point to efficient power output in economically competitive range

R. W. KLECKER, Project Engineer, Nuclear Power Department, Allis-Chalmers Mfg Co, Milwaukee, Wis.

Incorporation of a superheater loop within the nuclear reactor, along with controlled recirculation of the water, represents an important step toward economical nuclear power at the Pathfinder plant. Allis-Chalmers Manufacturing Co is prime contractor for the plant which is to be built near Sioux Falls, S. D. for Northern States Power Co. Central Utilities Atomic Power Associates, a non-profit corporation, including NSP and ten other utilities, AEC and Allis-Chalmers are participating in research. Construction is scheduled to start this summer, and operation in July 1962.

Pathfinder represents the second generation of boiling water type reactors. Its design will have definite economies over first generation types.

Superheat in the steam will improve cycle efficiency and permit more modern turbine design because of the higher steam temperature and a greatly reduced moisture problem. The controlled recirculation allows a smaller reactor vessel and core. The coolant will be forced through the reactor core at velocities higher than those obtained by natural circulation. Costs of installing and operating the pumps will be relatively low. Electrical requirements are estimated as less than 1% of gross electrical output.

The objective in designing and building the plant is the development of a nuclear fueled central station that most effectively utilizes all experience derived from todays's conventional steam plants. Investment costs will be kept to a minimum by means of a simple cycle incorporating standard components wherever possible.

Pathfinder's rated power will be 66 Mw. Total plant heat output will be about 203 Mw. Net power will be 62 Mw, resulting in an expected overall net plant efficiency of 30.5%. Steam conditions will be 600 psig and 825F. Operating experience gained from this plant will contribute significantly to future boiling water reactor plants with steam temperatures over 1,000F and pressures approaching those of conventional plants.

The Pathfinder research and development program is well underway. Initial operation will be followed by a

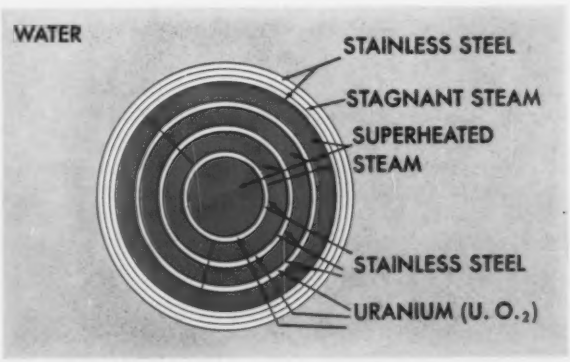

FIG 2—**FUEL-BEARING SUPERHEATER TUBES** will be concentric, with dead steam insulating steam from moderator

post-construction research and development program for optimization.

Except for the heat source, Pathfinder plant will be very much like a conventional central station and will be in a conventional type building. A steam line will take superheated steam directly to a tandem-compound, double-flow, 3,600-rpm turbine. The low-pressure turbine and generator will be conventional and will be rated 88,235 kva, 0.85 pf, 0.64 short-circuit ratio at 30 psig hydrogen. Special designs have been developed for the high-pressure turbine, valve system, and steam seal system.

Allis-Chalmers' new center line at floor level design will be used. The low silhouette will be accented by the absence of steam crossovers above the turbine. The condenser will be conventional, except for a slightly larger hotwell to accommodate water for filling the reactor during the refueling operation. Four feedwater heaters will raise the condensate temperature to 360F before it is pumped back into the reactor.

A primary coolant cleanup system, consisting of filter and ion exchange beds and other auxiliaries, will maintain purity of the primary coolant, and similar systems will keep water in the shield and fuel storage pools clean. The reactor water will be kept at a pH of about 6.5.

Incorporated in the reactor will be the cylindrical superheater, about 30 in. in dia and 6 ft long. The superheater will be surrounded by the boiler region. The two will comprise a single reactor core 6 ft in dia. Water will serve as the moderator.

Design Data for Controlled Recirculation Boiling Reactor with Nuclear Superheater

Plant

Power, boiling region	164,000 kw
Power, superheating region	39,000 kw
Steam flow at rated power	615,000 lb/hr
Total core power	203,000 kw
Gross electrical capability	66,000 kw
Net electrical output	62,000 kw
Net efficiency	30.5%
Steam outlet pressure	540 psi
Reactor operating pressure	600 psi
Temperature, boiling region	489F
Outlet temperature, superheating region	825F
Gross heat rate	10,370 Btu/kwhr
Containment shell size	50 ft by 115 ft

Reactor

Vessel size	11 by 26 ft
Core dimensions	6 by 6 ft
Superheating region	6 by 30 in.
	enriched UO_2
Fuel, boiling requion (aluminum clad)	approx. 1.7%
Fuel, superheating region (stainless steel clad)	approx. 92% enriched UO_2
Fuel, loading, boiling region	100kg (U_{235})
Fuel, loading, superheating region	24kg (U_{235})
Power density (boiling core coolant)	96 kw/liter
Avg heat flux, boiling region	131,000 Btu/hr/ft^2
Avg heat flux, superheating region	85,000 Btu/hr/ft^2
Max heat flux, boiling region	432,000 Btu/hr/ft^2
Max heat flux, superheating region	170,000 Btu/hr/ft^2
Recirculation rate	60,000 gpm
Recirc. pump power	620 kw

Power Distribution Optimized

Power distribution in the boiler and the superheater regions is optimum when the center of the reactor is used for the superheater. With this arrangement, the system can be designed for a more uniform power distribution than for a boiler core alone. The reactor vessel, about 11 ft in dia and 26 ft long, will have a carbon steel wall 2¾ in. thick, clad on the inside with a ¼-in. thick stainless steel liner.

Saturated steam, generated in the boiler region, will pass upward through moisture eliminators to the upper dome of the reactor vessel. From there, steam will turn and flow downward through a series of tubes containing the superheater fuel elements. These tubes will be double-walled, and will have a thin layer of stagnant steam between them to insulate the superheated steam from the cooler superheater moderator water on the outside. Superheated steam at 825F will enter a plenum below the core and leave the reactor through an insulated steam line at the bottom.

At full power, water circulation through the boiler core will be maintained at 24 million lb per hr (60,000 gpm). For part load operation, the recirculation rate will be reduced by controlling the pumps and/or valves in the three sets of recirculation lines entering and leaving the reactor vessel at the bottom.

As the water passes through the boiler region, a little more than 600,000 lb per hr will be boiled to saturated steam at 600 psi, 489F. The saturated water will turn and flow down through a series of centrifugal-type steam separators, which will remove any remaining steam bubbles. Removal of the steam bubbles minimizes the possibility of cavitation in the pumps.

Feedwater at 360F will be added from a distribution ring just below the steam separators. The 360F feedwater will reduce the water temperature in the reactor to about 486F before the water is recirculated. Recirculating pumps will be of mechanically sealed vertical-shaft design with overhung impeller positioned by a fluid piston type hydraulic bearing. They will be driven by conventional motors.

The pump installation will permit maintenance and repair during operation. Valves in the suction and discharge pipes will permit the servicing of one pump while the other two and the reactor are in operation. There will be radiation shielding between the pumps because of the slight radioactivity in the water.

Under present plans there will be 96 box-shaped aluminum boiler fuel elements about 5 in. square and 6 ft long. They will contain 0.42-in. dia fuel tubes in bundles about 18-in. long. Four bundles will be stacked end-to-end to make up the fuel assembly. The two lower bundles will have a nine by nine tube square lattice, the third an eight by eight tube square lattice,

and the top a seven by seven tube square lattice. This axial variation in fuel loading aids in optimizing the axial power distribution of the reactor.

Each tube will contain a stack of uranium dioxide fuel pellets clad with 0.04-in. aluminum alloy. The tubes will be mechanically bonded to the fuel pellets and sealed at the ends.

Stainless steel nozzles, attached at the lower end of the fuel elements, will locate them in the lower support grid plate. A fuel-handling fitting, also stainless steel, will be attached at the upper end of each element.

Fuel Is Concentric Tubes

The superheater region reference design consists of 429 fuel elements 6 ft long. The fuel will be in the form of two concentric tubes, one 0.46 in. in dia, the other 0.51 in. Each will be a sandwich of uranium dioxide-stainless steel cermet, clad on both sides by stainless steel. Superheater fuel elements will contain a burnable boron poison.

Superheater fuel tubes will be held together by spacers at the ends and maintained concentric by spirally wound wires. Each fuel element will have a nozzle at the lower end and a handling fitting at the top. They will be supported in a grid plate.

Surrounding each tube will be the double-walled insulation tube with an outer diameter of 1.08 in. This outer tube will isolate the hot steam and cooler moderator.

Boiler fuel will be enriched to about 1.7% and the superheater fuel will have high enrichment. Ultimately, it is planned to substitute low enrichment fuel in the superheater region.

When the reactor is started pressure will be built up to about 100 psi using nuclear heat. The control rods will be inserted, and the superheater steam channels drained. The reactor will be brought up to temperature, pressure, and steam flow gradually by using nuclear heat. Steam will be bypassed to the condenser until conditions are such that it can be used in the turbine either for warmup or power generation.

Rods Control Superheat

Reactor power will be adjusted by control rods in the boiler and the superheater regions and by control of the recirculation flow in the reactor. Control rods will be actuated by control-rod drives mounted on the vessel cover. The arrangement will permit rapid emergency shutdown. Rods in the superheater region will also be used to regulate the superheated steam temperature. By-pass steam to the condenser will be for overpressure protection only.

Above the reactor there will be a pool of water 18 ft deep. It will function as a shield and will permit access to the reactor for refueling and maintenance. The pool will be insulated from the hot reactor during operation. Shielding on the other sides will be by about 10 ft of concrete.

When the reactor is shut down, pressure will be reduced in a controlled manner to provide steam cooling of the superheater until low temperatures are reached. Steam will be dumped to the condenser during this operation. The superheater will then be flooded with water for refueling. Refueling will be accomplished by completely filling the reactor vessel with water from the condenser hotwell. When temperatures of the reactor and pool water have been equalized, the reactor cover will be removed to provide access to the core. Refueling will be completed with long-handled tools through water sufficient for shielding.

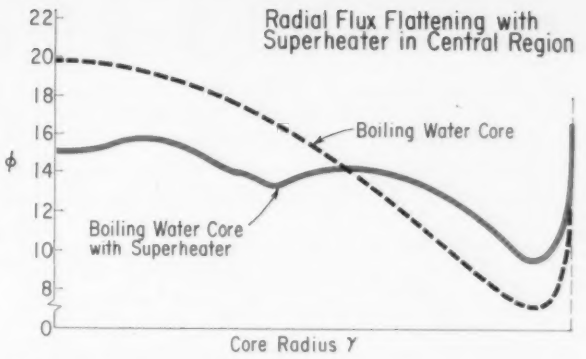

FIG 3—POWER DISTRIBUTION in controlled circulation boiling reactor with superheater has attractive uniformity

Used fuel will be pulled up into the shielding pool and placed in a carriage that will transport it through the underwater tube to a fuel storage pool in an adjacent building. New fuel will be brought in through the same tube.

To Refuel Yearly

Fuel life is expected to be about one year. Plans call for the superheater to be refueled once a year and one-third the boiler fuel to be replaced three times a year.

As in all nuclear power plants, safety of plant personnel and general public have been given every consideration. The reactor, shielding, pumps, emergency coolers, and associated equipment will be within a containment shell, a steel structure 50 ft in dia and 115 ft high.

While many maintenance procedures will be standard, some will be restrictive. By suitable placement of plant components, adequate shielding of walls and floors, and compartmentization, radiation will be absent or kept well below tolerance levels where personnel work. Safety devices will be located throughout the plant. The reactor building will be air tight and capable of containing a release of all the energy stored in the primary system.

There will be an emergency coolant circuit for the reactor, and isolation valves in appropriate lines penetrating the reactor building. Pathfinder should be as safe as any conventional plant.

The Pathfinder project will further the development of economical nuclear power. Research and development experience gained from it will lead to improvements and cost reductions on future generation plants.

In the future plants power output may be increased proportionately by increasing pressure without change in vessel size. High-strength steel will keep vessel wall thicknesses reasonable. Increased capacity from a modest increase in capital cost will cut cost per installed kw. Experience and advances in technology will lead to higher steam temperatures, higher efficiencies and lower fuel and operating costs.

Reactor Studies Bring Definition

Significant progress in nuclear power over the past 12 months assumed the shape of definition; definition of the several paths of nuclear development open to the power industry, of time schedules available along these paths, of production costs achievable, and of dollar outlay.

Such definition, absolutely necessary to permit concrete, systematic and businesslike industry planning, was formulated by studies initiated and carried out by manufacturers, consultants, utilities, and government, independently and in combination. It was made possible by a year full of data rolled out by the five operating power reactors and numerous non-power pilot plants, most of which had achieved criticality this time last year.

Some of the more important programs and proposals stemming from these definitions are presented by Electrical World on the pages preceding. Specifically, here can be seen strong claims of nuclear power in the range of close-cost competition with fossil-fuel sources in parts of the U. S. According to the authors, plants capable of such achievement can be ready within the next decade. But no simple paths, no "breakthroughs," are idly promised. Each article lays it on the line, again in definition, with the hard work and cash requirement spelled out.

No New Criticals

Looking for evidence of progress in terms of steel and concrete and newly spinning equipment, one might be disappointed if the hiatus of the past year had not been expected. For not a single new power reactor plant went critical. Probably only one more (Dresden) will be operating this time next year. True, four construction starts were made—Hallam, Elk River, Fort Greeley, and EBR-2. These doubled the number of plants in erection. But they added only 125 eMw gross generating capacity to the 704 eMw already building at Indian Point, Dresden, Yankee, and Enrico Fermi. Next month, they'll be reinforced by initial construction at Pathfinder, adding 66 eMw more.

The five operating stations—Shippingport, EBWR, Vallecitos, SRE, and Fort Belvoir—continued developmental and training programs. One measure of their activity is the kwhr they produced last year, five times as much as the entire previous total. But the kwhr output pales in importance beside their contribution to basic engineering data for the definition studies mentioned.

Three plants in Electrical World's tabulations last year have disappeared. PAR, the homogeneous slurry reactor, was dropped regretfully by its sponsors when continued investigations revealed difficulties out of proportion with those of parallel programs. Wolverine Electric Co-op's proposal, another homogeneous reactor, was eliminated, but Wolverine may make another proposal, this time for a direct-cycle boiling, variable-moderator plant now in initial investigation stages. The other dropped project was Chugach (Alaska) Electric Association's sodium-deuterium plant.

Replacing these three were three new ones. The Army Engineers' SM-1A already is in construction at Fort Greeley, Alaska. Essentially a repetition of the successful SM-1 (formerly APPR-1) operating at Fort Belvoir, Va., SM-1A will have a larger reactor to permit space heating load takeoff.

The second is the High Temperature Gas-Cooled plant projected for the Philadelphia Electric Co system. It would be built for that utility and 51 other private companies forming the High Temperature Reactor Development Association, if Congress appropriates the research and development contribution recommended by AEC and JCAE.

Last is a small development station proposed by General Public Utilities at Saxton, Pa.

In addition to these new developments, at least two big private utility systems have reaffirmed their intention to build large nuclear stations on their systems. New England Electric System hopes to put one, probably exceeding 200 eMw, in place sometime in the mid-sixties. The reactor type is not yet selected. Pacific Gas & Electric continues to study proposals for a large-scale reactor, for which it has chosen a coastal site. PG&E management has reiterated its plan for at least one plant of at least 200 eMw to be in service by 1965, if it can see production economically competitive with system plants by that time.

Nuclear superheat became a familiar term this year for the first time. Attainment of superheated temperatures without use of fossil fuel superheaters has a strong appeal. Importantly, the first plant to have a nuclear superheater designed into initial construction will soon be building, and one of the articles gives a complete description. A myriad of additional experimental installations on nuclear superheat are under way, and more are proposed. One, at GE's Vallecitos Laboratory, already has produced superheated steam in an in-pile loop.

Federal Funds Authorized

As this Report goes to press, Congress' Joint Committee on Atomic Energy reported out the 1960 AEC authorization bill, which would provide for federal construction of, or participation in, nine new civilian reactor plants. Two probably would have no electrical generation.

The bill would authorize government R&D funds for the Philadelphia Electric-HTRDA high-temp gas-cooled 40-eMw plant. It would permit federal construction of a "flexible experimental prototype" gas-cooled graphite-moderated plant based on an Allis-Chalmers (formerly ACF)-Kaiser 25 eMw design.

The AEC would be authorized to participate in five other small plants, at least two of which might be built in cooperation with public agencies. One of the five would have nuclear superheat features.

The bill also would authorize AEC expenditures to expand Shippingport electrical capacity to 150 eMw, instead of the originally-planned 100. Expansion plans are subject to Duquesne Light Co's agreement to install the necessary larger conventional equipment.

Significantly, no large (over 100 eMw) new plants were recommended. Total federal outlay authorized for the nine reactors would be about $106 million.

Nuclear Power Plants Now Operating

Company	Duquesne Light Co	Argonne Nat'l Lab (AEC)	Pacific Gas & Elec Co; General Electric Co	Southern California Edison; North American Aviation, Inc	U. S. Army Corps of Engineers
Plant	Shippingport, Pa	EBWR, Lemont, Ill	VBWR, Vallecitos, Calif	SRE, Santa Susana, Calif	SM-1 (APPR-1), Fort Belvoir, Va
Critical	Dec. 2, 1957	Dec. 1, 1956	Aug. 5, 1957	Apr. 25, 1957	Apr. 8, 1957
Full Power	Dec. 23, 1957	Dec. 29, 1956	Oct. 24, 1957	May 22, 1958	Apr. 15, 1957
Reactor type	Pressurized water	Boiling water	Boiling water	Sodium graphite	Pressurized water
Reactor Mfgr	Westinghouse Elec Corp	Argonne Nat'l Lab	General Electric Co	North American Aviation, Inc	Alco Products, Inc
Reactor thermal Mw, (design)	236	20	20	20	10
Reactor thermal Mw, (reached)	236	61.7	30[4]	21.0	10
Gross generating capacity, Mw	68 (100-ultimate)	5	5	7.5	2
Total output, kwhr (as of .....)	248,400,000 3/23/59	31,704,000 2/13/59	20,603,000 5/17/59	12,000,000 3/25/59	11,335,000 2/28/59
Estd cost of reactor, $ million[1]	55.0	1.95	2.5[5]	6.58	1.24 (primary system)
Estd cost, turbo-gen plant, $ million	20.0	2.68	0.572	1.3	1.22 (secondary system)
Total estd plant cost, $ million	75.0	4.63[3]	3	7.88	3.8 plus gov't costs
Total estd plant cost, $ per kw	750 (at 100 Mw)	900[3]	600 (at 5 Mw)	1,050	1,900
Estd energy cost, mills per kwhr	Downward trend from earlier 64.4	52[3] (at 20 tMw)			
Moderator	Light water	Light water	Light water	Graphite	Light water
Coolant	Light water	Light water	Light water	Sodium	Light water
Coolant temp, F[2]	500	486	545	960 (outlet)	450
Coolant press, psi	1,800	600	1,000	3	1,200
Steam temp, F	Saturated	489	545	825	407
Steam press, psi	520	600	1,000	600	200
Steam flow, lb per hr	850,000 (at 60 Mw)	60,600	61,000 at 5 eMw 90,000 at 30 tMw	75,500	34,070
Fuel enrichment % U-235	In excess of 90% in seed. Natural uranium in blanket	1.44	Enriched UO_2 in stainless steel cladding	2.8	Highly enriched

[1] Not including R&D, fuel fabrication for first charge, or nuclear materials unless noted otherwise.
[2] Avg temp of coolant in reactor unless noted otherwise.
[3] Based on 50-Mw thermal operation, with $750,000 extra capital for additional turbo-gen capacity and present fuel, total plant cost would be $5.25 million but unit cost would be lowered to $420 per kw and power costs to 33 mills per kwhr.
[4] Authorized to operate at 50 tMw max.
[5] Not including land, supporting facilities and similar items required for commercial-sized reactor plant.

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Nuclear Power Plants Going Up

Company	Consolidated Edison Co	Commonwealth Edison Co; Nuclear Power Group	Yankee Atomic Elec Co	Power Reactor Development Co; Detroit Edison Co
Plant	Indian Point, Buchanan, N. Y.	Dresden, Morris, Ill	Rowe, Mass	Enrico Fermi, Lagoona Beach, Mich
Type of financing	Privately financed	Privately financed[5]	AEC Power Demonstration Program	AEC Power Demonstration Program
Status of project	Under construction	Under construction	Under construction	Constr proceeding under conditional permit
Reactor type	Pressurized water	Dual cycle boiling water	Pressurized water	Fast breeder
Reactor mfgr	Babcock & Wilcox Co	General Electric Co	Westinghouse Elec Corp[8]	Power Reactor Development Co
Reactor thermal Mw	585	626	492 (392 initial)	300
Gross generating capacity, Mw	275[3]	180 (net)	145 (120 initial)	104
Estd cost of reactor, $ million[1]	45.0[4]		24.2[9]	37.6
Estd cost, turbo-gen plant, $ million	55.0		15.4[9]	17.0
Total estd plant cost, $ million	100.0	45.0[6]	53.1	54.6[10]
Total estd plant cost $ per kw	363	250[6]	366	546[10]
Estd energy cost mills per kwhr	14.3	9–7.5[7]	12–14 (mid 1960's)	
Estd operating date	1961	1960	End of 1960	Sept/Oct 1960
Moderator	Light water	Light water	Light water	None
Coolant	Light water	Light water	Light water	Sodium
Coolant temp F[2]	500	525	508	800 (outlet)
Coolant press, psi	1,500	1,000	2,000	127 (pump discharge)
Steam temp, F	1,000[3]	546 primary) 467 (secondary)	470	740
Steam press, psi	370	1,000 (primary) 500 (secondary)	500	600
Steam flow, lb per hr	2,200,000	1,400,000 (primary) 1,200,000 (secondary)	1,800,000	960,000
Fuel enrichment, % U-235	Fully enriched. Thorium used as fertile material	1.5	3.4	26

[1] Not including R&D, fuel fabrication for first charge, or nuclear materials unless noted otherwise.
[2] Average temp of coolant in reactor unless noted otherwise.
[3] Will use separately oil-fired sphtr to raise steam temp from 450 to 1,000F. Sphtrs will provide 112 Mw of capacity, reactor 163 Mw.
[4] Nuclear portion of plant.
[5] Commonwealth Edison will pay $30 million plus $6 million for site and overheads (charged to plant account). Remaining $15 million will be supplied over period of five years by Nuclear Power Group, incl. Comm. Ed.

Company	Consumers Public Power District, Columbus, Nebr	Elk River Rural Cooperative Power Assoc.	Argonne Nat'l Lab (AEC)	U. S. Army Corps of Engrs.
Plant	Hallam, Nebr	Elk River, Minn	EBR-2 Arco, Idaho	SM-1A (APPR-1a) Fort Greeley, Alaska
Type of financing	AEC Power Demonstration Program	AEC Power Demonstration Program	Federal	Army
Status of project	Under construction	Under construction	Under construction	Under construction
Reactor type	Sodium graphite	Boiling water	Fast breeder	Pressurized water
Reactor mfgr	North American Aviation, Inc.	Allis-Chalmers Mfg. Co	Argonne Nat'l Lab	Alco Products, Inc.
Reactor thermal Mw	254	58.2	62.5 Gross	20
Gross generating capacity, Mw	81	22	20	1.6[13]
Estd cost of reactor, $ million[1]	29.0	9	8.5	1.5
Estd cost of turbo-gen plant, $ million	12.3	2.7	9.5[11]	2.0
Total estd plant cost, $ million	41.3	11.7	29[12]	5.7 plus gov't costs
Total estd plant cost $ per kw	550	534	1,450[12]	1,425 per equivalent kw (less gov't costs)
Estd energy cost mills per kwhr	10–11	20.7		
Estd operating date	1961	5/31/61	1960	Summer 1960
Moderator	Graphite	Light water	None	Light water
Coolant	Sodium	Light water	Sodium	Light water
Coolant temp F[2]	950 (outlet)	538	900 (outlet)	435
Coolant press, psi	10	950	60	1200
Steam temp, F	825	538 (primary) 506 (secondary)	840	382
Steam press, psi	800	935 (primary) 715 (secondary)	1300	200
Steam flow, lb per hr	730,000 (gross)	258,000 (primary) 225,000 (secondary)	249,000	70,000
Fuel enrichment, % U-235	2.5	Fully enriched U in thorium oxide	49	Highly enriched

[6] Based on contract price.
[7] For second and later cores; not capitalizing $15 million R&D.
[8] Plant design joint with Stone & Webster.
[9] Equipment & installation only.
[10] If R&D and fuel costs are added, cost is $82.7 million, $783 per kw.
[11] Including secondary sodium system and steam system.
[12] Including fuel recycle plant and general facilities.
[13] Plus 40,000 lb per hr of steam for space heating

Nuclear Power Plants in Planning

Company	Central Utilities Atomic Power Associates	Pacific Gas & Elec Co	Fla West Coast Nuclear Group; East-Central Nuclear Group[4]	Carolinas-Virginia Nuclear Power Associates, Inc.[6]
Plant	Pathfinder Sioux Falls, S. D.	Humboldt Bay, south of Eureka, Calif.	Florida	Parr, S. C.
Type of financing	AEC Power Demonstration Program	Privately financed	AEC Power Demonstration Program	AEC Power Demonstration Program
Status of project	Construction to start 7/59	Detail design in progress	Proposal submitted to AEC	Prelim R&D and plant design in progress
Reactor type	Boiling water, controlled recirculation, nuclear sphtr	Boiling water	Gas-cooled, heavy-water moderated, pressure tube	Pressurized water, pressure tube
Reactor mfgr.	Allis-Chalmers Mfg. Co	General Electric Co		Westinghouse Elec Corp
Reactor thermal Mw	203[3]	165/197		60.5
Gross generating capacity, Mw	66	50 guaranteed 60 expected	50	19
Estd cost of reactor, $ million[1]				4.3
Estd cost of turbo-gen plant, $ million				Utilizing existing plant
Total estd plant cost, $ million	33.1	Approx 20	25.9	22 (incl escalation)
Total estd plant cost, $ per kw		400 on guaranteed 333 on expected		1,300
Estd energy cost, mills per kwhr		Estd 8.0 with second core		
Estd operating date	1962	Mid 1962	1963	1962
Moderator	Light water	Light water	Heavy water	Heavy water
Coolant	Light water; steam for sphtr	Light water	Gas	Heavy water
Coolant temp, F[2]	489	545	1,050 outlet[5]	550
Coolant press, psi	600	1,000	520[5]	1,500
Steam temp, F	825[3]	545	1,000[5]	725
Steam press, psi	540	1,000	1,000-1,800[5]	400
Steam flow, lb per hr	615,000	580,000 at 50 Mw		203,000
Fuel enrichment, % U-235	1.7 boiler 92 sphtr	2% in UO_2 zircaloy clad	Slightly enriched	Under 2%

[1] Not including R&D, fuel fabrication for first charge, or nuclear materials unless noted otherwise

[2] Average temperature of coolant in reactor unless noted otherwise

[3] Will use nuclear sphtr to raise steam temp from 489 to 825F. Sphtr will provide 39 Mw, reactor 164 Mw.

[4] Members of FWCNG are: Florida Power Corp. and Tampa Electric Co. Members of ECNG are: Appalachian Electric Power Co., Ohio Power Co., Columbus & Southern Ohio Electric Co., Louisville Gas & Electric Co., Pennsylvania Power Co., Monongahela Power Co., West Penn Power Co., Indiana & Michigan Electric Co., Cleveland Electric, Illuminating Co., Dayton Power & Light Co., Ohio Edison Co. Southern Indiana Gas & Electric Co., Potomac Edison Co., Indianapolis Power & Light Co.

[5] Design objectives

[6] Members of CVNPA are: Carolina Power & Light Co., Duke Power Co., Virginia Electric & Power Co., South Carolina Electric & Gas Co.

Municipal Power Dept, Piqua, O.	Phila Elec Co; High Temp Reactor Development Associates	General Public Utilities Corp
Piqua, O.	HTGC, Peach Bottom, Pa	Saxton, Pa
AEC Power Demonstration Program	AEC Power Demonstration Program[8]	Nonprofit membership corporation--contribution
Contract signed	Proposal submitted to AEC	Contract under negotiation
Organic cooled and moderated	High-temp gas-cooled	Pressurized water
No. American Aviation, Inc	Gen'l Atomic Div, Gen'l Dynamics Corp	Westinghouse Electric Corp
45.5	115	20
10.5	46	12
4.5[7]		6.25[10]
1.03 (existing plant)		Existing turbine generator
15.3[7]	24.5[9]	
	610[9]	
10–11[7]		
1961	1963	1962
Terphenyl	Graphite	Light water
Terphenyl	Helium gas	Light water
575	1,380	505
120	300	2,000
550	1,000	Saturated
450	1,450	300–450
150,000	367,000	73,000
1.8	Highly enriched U 1:6.25 with thorium	3–5

[7] Costs being revised to provide for complete reactor containment

[8] Philadelphia Electric would provide $8 million, HTRDA $16.5 million, AEC would support R&D up to a reimbursable $14.5 million and waive up to $2.5 million use charges on source and special nuclear materials.

[9] Fixed price contract including escalation

[10] Including fuel charges for 5 yrs (two or more cores)

330-eMw PWR Plant

(*Continued from page 69*)

the specific site and its transportation facilities. The vessel is about 140 in. ID, 10 in. thick, and 48 ft high. All control rods will be mounted on the head and all penetrations will be above the core top. The vessel is carbon steel, clad on the inside with stainless.

Steam generators are of vertical shell and tube design with integral steam drums. Forgings for the tube sheet, 114 in. dia and 23 in. thick, though larger than any yet produced, can be made available.

The plant is designed to be operated as a unit system, therefore does not need main-coolant-loop stop valves. Check valves are used, not only to avoid back flow through a shut down main coolant pump but also to prevent coolant in the remaining loops bypassing the core.

The turbine-generator represents a significant forward step in design for dry and saturated steam conditions. This turbine is an 1800-rpm tandem-compound, double-flow high-pressure, quadruple-flow low-pressure unit. It is designed for a throttle flow of approximately 4,300,000 lb per hr with 680 psia at the heat exchanger and 1.5-in. exhaust. A single stage of moisture separation will be used between high- and low-pressure elements.

Table II gives a power cost breakdown on the 330-Mw plant. Capital cost is about $78 million or $236 per net kw. At 14% capitalization rate and 80% plant factor, capital cost is 4.7 mills per kwhr. Operation and maintenance are estimated at 0.7 mills per kwhr. Operating costs are based on an assumed staff of 57 people. Annual maintenance is estimated at 1% of plant cost.

Table III gives a breakdown of fuel costs expected during early cycles. It shows the amount going into preparation, use, and cleanup, and indicates expected areas of cost reduction for future cores. This fuel cost is based on a plutonium credit of $12 per gram. If plutonium is credited at $30 per gram, fuel cost will be reduced about 1.2 mills per kwhr.

Interest already expressed in this plant by the utility industry has been an incentive to make final designs and detail costs which will be disclosed later this year.

Organic Cooled Reactor Design Can Produce Power Cheaply

(*Continued from page 67*)

Present work on process technology development, including radiation effects, purification, coolant reclamation, and basic physics measurements are required for about two to four more years.

Since organics are chemically compatible with uranium metal and uranium oxide, fuel choice can be on purely economical grounds. It is expected that each type will be most suited for certain applications. Thus development work on aluminum-clad, low-alloy uranium-metal fuels along with APM-clad uranium oxide fuel is needed for the next three and a half years.

Analytical studies show organic reactors can operate on the natural-uranium plutonium-recycle fuel program. Such a program is shown running from mid-1961 to the end of 1965.

A component proof-testing development effort is shown, starting in mid-1959, covering four years. It is specifically for an intermediate (75-Mw OMCR) reactor and for a large organic-cooled reactor plant (300-Mw OMCR).

The program calls for OMRE operation for about another year and a half. This would include complete burnup of the second core loading of stainless steel UO_2 plate-type elements and a partial loading of APM-UO_2 rod-type elements. Additional facilities for the present OMRE and provision of some in-core experimental facilities, permitting nucleate boiling, would be completed by the end of 1960, with initial operation in early 1961.

A second test reactor, Organic Test Reactor (OTR), is proposed for initial operation in late 1961. It would be designed to enlarge organic coolant chemistry knowledge, determine means of decreasing coolant decomposition rate, achieve better understanding of reactor physics, perform heat transfer studies, and test fuel element designs in large units in a high temperature environment.

The Piqua plant, now entering design, is scheduled for July 1961 completion. Steam conditions are 450 psia, 550F. Design studies show reactors based on the Piqua concept have good potential in the small and intermediate range (up to 150 eMw net).

Two additional reactors of this type are shown starting design in late 1959, an advanced organic reactor of 5 to 40 Mw for small utility power plants, with improved steam conditions over the Piqua plant, and a 150-Mw OMR suitable for the Euratom program with 430 psig 550F steam.

The costs of all reactor plants are based on 1959 dollars escalated over the construction period shown (at 4% annually) and include interest on funds during construction (at ½ of 1% monthly until start of commercial operation). All costs are for 80% plant factor and 14% annual capital charges.

Neither plant requires any more research and development than indicated in the basic programs.

Under advanced designs three plants are shown. These plants base on studies and conceptual designs developed during the Phase I effort of the AEC Organic Cooled Reactor Study of Bechtel and Atomics International, made between Dec. 1958 and Apr. 1959.

It is recommended that design of a 75-Mw OMCR plant be initiated in July 1959, leading to full power operation in July 1963. This reactor would be like the 300-Mw OMCR described, but would have 1000 psig/650F steam conditions. It would produce power at 13.1 mills per kwhr one year after operation and 12.2 two and a half years later. Decreasing power costs result from expected reduction in organic makeup and fuel preparation and fabrication costs, improved neutron economy by replacing core stainless steel with APM, extension of fuel life, and realization of plant design margin.

Following the 75-Mw plant by six months is the 300-Mw plant. It would operate by early 1964 at 8.1 mills per kwhr after a year's operation and at 7.2 mills two years later.

In mid-1961 a purely commercial power plant could be initiated. It should use the largest single-shaft turbine available (estimated at 450 Mw with 1000 psig/650-700F steam). It could operate by 1966, and produce at 7.0 mills per kwhr by 1967 and 6.1 by mid-1969.

BWR's Economy, Potential Spur Development

(*Continued from page 72*)

scale plants. GE has outlined what it believes the most prudent mixture. Fig 3 illustrates the proposed program.

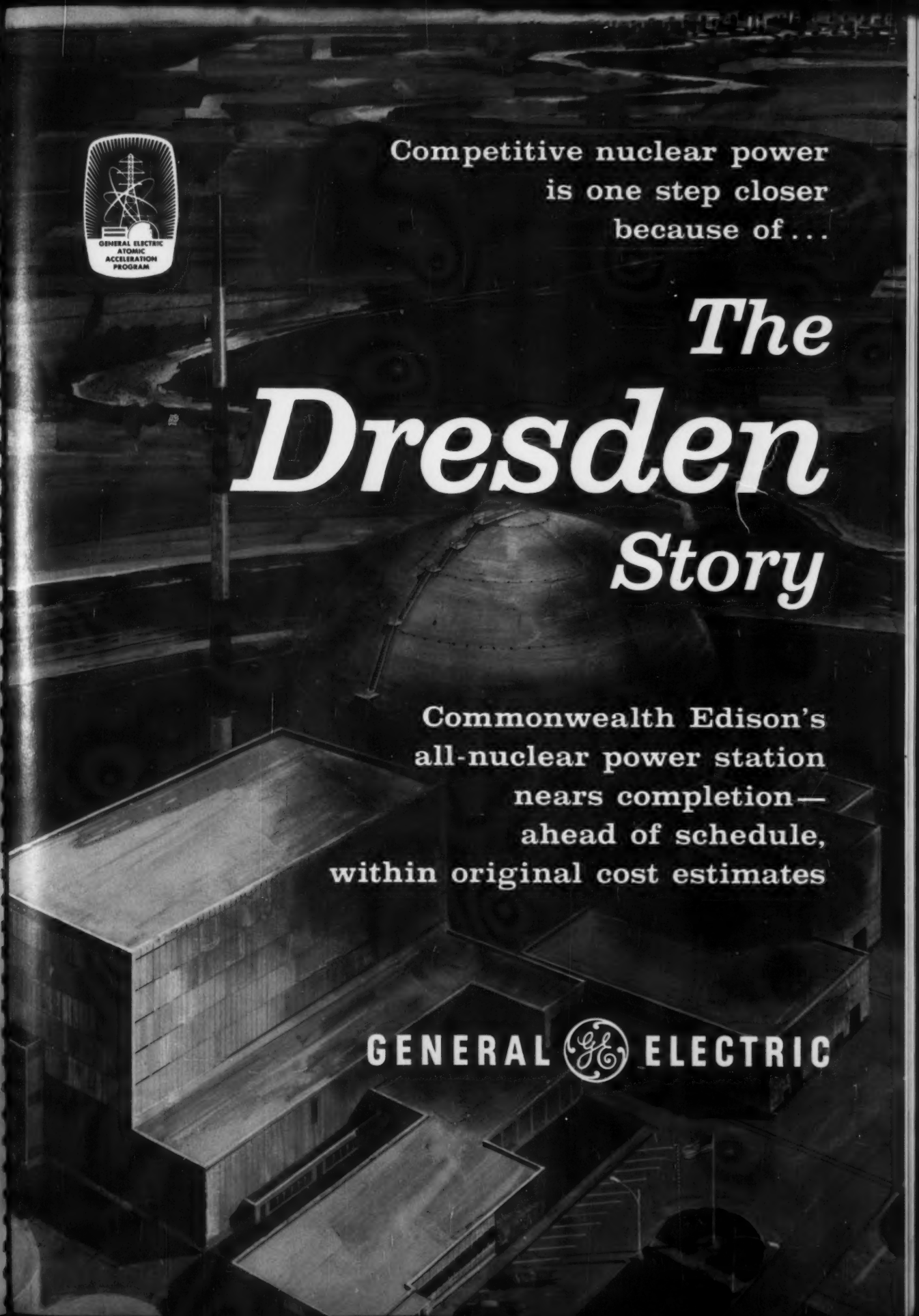
The sequence should be emphasized. It begins with the technical foundation given by Dresden and other first-generation plants in Phase I, and culminates with target plants in Phase IV, being designed in 1965, and expected to be competitive in a significant portion of the U. S.

Complementary paths of advancement include natural circulation, forced circulation-compact series, forced circulation-high power density series, and nuclear superheat. The results from each will be applied to the others. As the program proceeds, GE expects a narrowing of the number of parallel approaches. It has purposely omitted defining the evolutionary and target plants to emphasize that these will blend the best features of the early plants.

Success in meeting these objectives is not dependent upon the complete success of all four complementary avenues of advancement. Complete success would result in bettering the established economic goal. This feature provides flexibility and credibility of the program.

Expected economic results of the planned BWR program are shown in Fig 4 and 5. Note that all incremental improvements are not necessary to reach target objectives. Success in all areas, quite possible, would take GE well below the target.

Fig 5 shows the expected boiling water reactor total power generation cost. The effects of plant size and the time it is designed are shown. Though time extrapolations are only shown through 1965, it is reasonable to assume technical improvements will continue beyond, producing still lower power cost.


GENERAL ELECTRIC
ATOMIC
ACCELERATION
PROGRAM
Competitive nuclear power
is one step closer
because of . . .
The
Dresden
Story
Commonwealth Edison's
all-nuclear power station
nears completion—
ahead of schedule,
within original cost estimates
GENERAL ELECTRIC

The Dresden Story: ahead of schedule,

DEVELOPMENT AND CONSTRUCTION COSTS for Dresden are within the original estimate made by General Electric prior to contract signing in 1955, showing that boiling water reactor costs can be forecast accurately.

DRESDEN—THE NATION'S LARGEST ALL-NUCLEAR POWER PLANT at 180 mw—is scheduled for operation early in 1960. Here, the 190-foot-diameter steel containment sphere begins taking shape in September, 1957.

Dresden Project experience will demonstrate the lower total energy cost potential of the boiling water reactor

The Dresden Nuclear Power Station being built for Commonwealth Edison of Chicago and the Nuclear Power Group, Inc.,* will provide 180 mw of electrical power in 1960. Design is now 100% complete, and construction 83% complete on this country's largest all-nuclear power plant. Construction is six months ahead of schedule, costs within original estimates. Engineer-constructor for the station is Bechtel Corporation. Project experience at Dresden will help develop the lower total energy cost potential of the boiling water reactor system, notably in the area of reduced capital costs.

The Dresden design added to other General Electric atomic experience shows that capital costs for the boiling water reactor are lower than for any other type of proven reactor because:

1. Steam flows directly from the reactor to the turbine, permitting elimination of expensive and space-consuming heat exchangers and an auxiliary system.

2. The use of water as a coolant is a well-known technology, and more conventional materials can be used.

3. Simplicity of the boiling water reactor cycle allows the design of a compact plant, saving construction time and materials.

Dresden experience enables General Electric to quote firm prices for BWR plants because of known technology and confirmed design. An explicit endorsement of this ability was the choice of a General Electric 150 mw(e) boiling water reactor plant for Italy's Garigliano nuclear power plant (SENN) over all competitive reactor systems. The selection, made by three teams of independent power plant and nuclear experts, was based on demonstrated capability, power-producing potential, and low total power generating costs of the BWR.

Dresden—a milestone on the road to competitive nuclear power—reaffirms General Electric's conviction that the boiling water reactor will achieve economical nuclear power faster and at lower cost than any other reactor system.

*American Gas & Electric Service Corporation, Commonwealth Edison Company, Pacific Gas & Electric Company, Union Electric Company of Missouri, Illinois Power Company, Kansas City Power & Light Company, Bechtel Corporation, Central Illinois Light Company.

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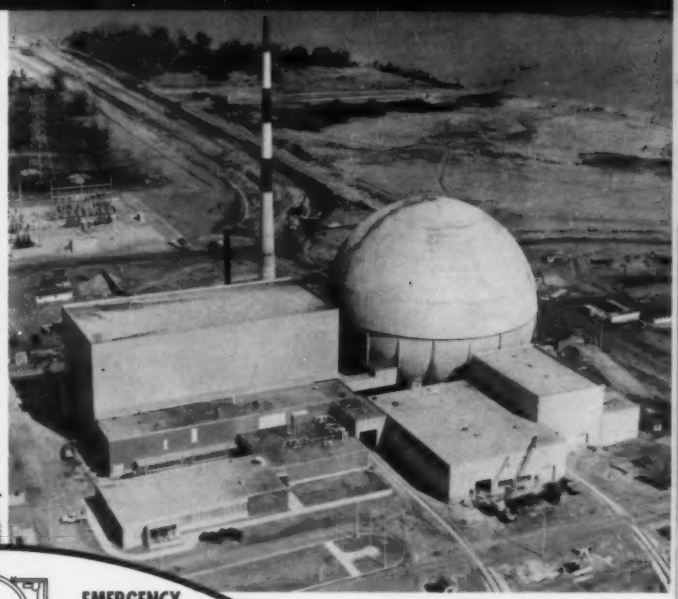
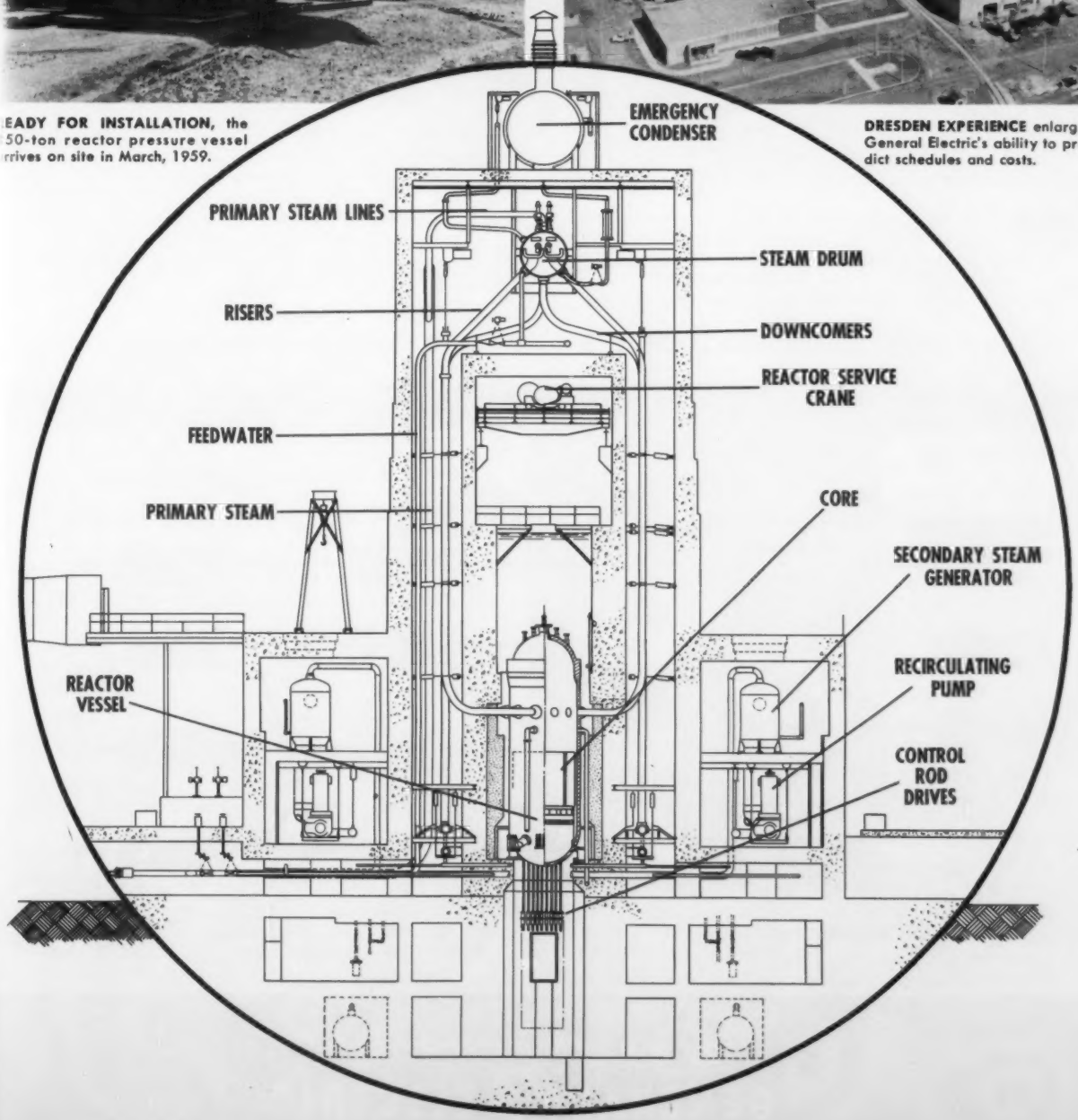
within original estimates

EADY FOR INSTALLATION, the 50-ton reactor pressure vessel rrives on site in March, 1959.



DRESDEN EXPERIENCE enlarges General Electric's ability to predict schedules and costs.



after Dresden...acceleration

General Electric's Atomic Acceleration Program can realize the potential for low total energy costs demonstrated at Dresden

Acceleration to competitive nuclear power is necessary for national security and world leadership, technical and ideological. General Electric's Atomic Acceleration Program—a major effort in developing boiling water reactors in depth—promises the fastest realization of that goal, at minimum cost and least technological and financial risk. This industry-wide program complements government objectives and is designed to assist industry prepare for broad scale use of atomic power. General Electric will continue to investigate other promising reactor types.

The Dresden reactor—in the First Generation Phase of the program—will speed realization of the lower total energy cost potential of boiling water reactors. Immediate implementation of the Developmental Phase is necessary with these reactors planned to improve and test specific combinations of boiling reactor technology:

NCB-2 The **NATURAL-CIRCULATION BOILER** reactor, rated at 50 mw(e), has been committed by Pacific Gas & Electric Co. for the Humboldt Bay station and will stress extreme simplification and lowered costs.

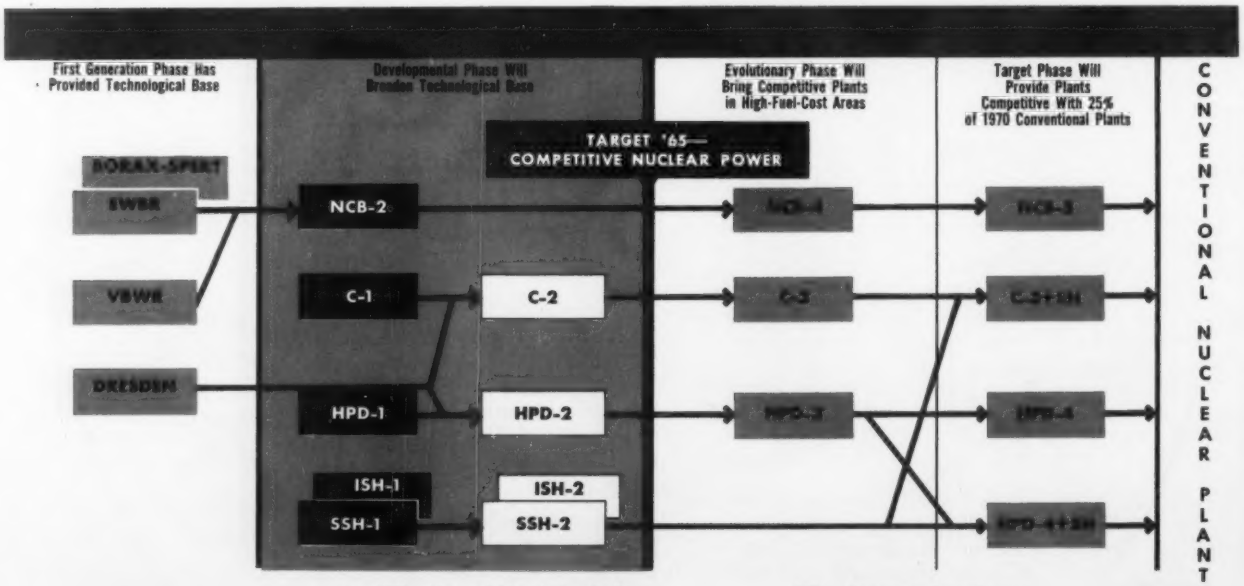
C-1 A **COMPACT** reactor, rated at 10-25 mw(e), is required to develop optimum design and construction simplicity for forced-circulation plants.

HPD-1 A **HIGH POWER-DENSITY** reactor, rated at 25-50 mw(e), is required to test the limits of power density and provide full-scale proving of high-power-density fuel.

SSH-1 or ISH-1 A **SEPARATE SUPERHEATER** or **INTERNAL SUPERHEATER,** rated at 10-100 mw(e), is required to evaluate operation and maintenance characteristics, extend nuclear superheat technology.

FOR INFORMATION on participation in this program, contact your nearest General Electric Apparatus Sales Office or write: Atomic Power Equipment Department, 2151 South First Street, San Jose, California. Publications GED-3750, "How to Implement Nuclear Power Acceleration" and GER-1574, "Operation Sunrise," provide more detailed discussion of the program, are obtainable by writing Section 192–14, General Electric Co., Schenectady 5, N. Y.

THE COMPLETE ACCELERATION PLAN FOR COMPETITIVE NUCLEAR POWER



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Isotopes Chart Cooling Water Flow

Melbourne — (McGraw-Hill World News)—Two series of tests in Australia have successfully used isotopes to determine the suitability of an artificial lake as a source of cooling water.

The first series was carried out with condenser cooling water pumped from the lake through an intake located near the surface of the lake. The second series was aimed at determining the effectiveness of a submerged intake.

The isotope used was Iodine 131, and about 500 millicuries were flown in from England. First, 20 lb of green fluoroscein dye was emptied into the outlet canal from the station to the reservoir. At the same time, iodine isotopes were removed from lead sheaths with long-handled tongs and crushed into a solution of non-active potassium iodide.

A flying fox, remotely controlled by ropes, was used to tip the solution into the lake shortly after the fluoroscein dosing. The spread of the dye could be followed visibly for five to six hours.

Isotopes were traced with scintillometers operated from a number of boats. Boats were controlled from a base observation point by two-way radio. The position of the dye and isotopes was plotted at regular intervals.

Thermostat Controls Secondary Capacitors

HENRY J. FORD, Test Engineer, City Public Service Board, San Antonio, Tex.

Bi-metal disk thermostats are used by City Public Service Board of San Antonio to control secondary capacitor switching. Secondary capacitors are installed to release maximum transformer capacity in residential areas in the summer when demand is highest. This produces a leading power factor during off-peak winter periods which can cause operating difficulties, especially when system disturbances occur in light load periods.

The thermostat used will switch a 5-kva secondary capacitor for less than 50¢ per kva. It is manufactured by the Spencer Thermostat Div, Metals and Controls Corp. A neoprene covering weatherproofs the thermostat.

A life test of the thermostat was stopped after over 10,000 operations, representing a normal service of about 200 years. At the end of the test the contacts still operated normally with no measurable change in contact resistance.

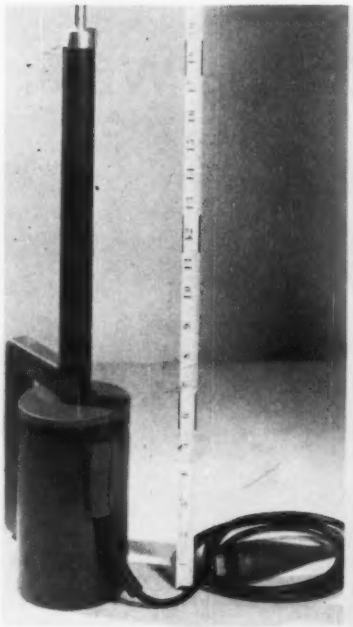
Fixed secondary capacitors furnish minimum off-peak winter requirements. Switched secondary capacitors supply the increase in minimum requirements for the summer months.

The peak load winter requirements are furnished by time-switched primary capacitors. Additional peak load summer requirements are supplied with time-switched primary capacitors with a temperature override to keep the capacitors off the line during the winter. Winter requirements are such that some of the capacitor banks must be taken off the system entirely.

The same thermostat used to switch secondary capacitors is also used to override the time switch. In this case, however, it is not necessary for the thermostat to have a neoprene covering. The thermostat is mounted in a hole in the bottom of the time switch case.

Bell Device Safely Tests 2.4-Kv Lines

J. H. **WINTER, JR,** Engineer, Electric Distribution Dept, Baltimore Gas & Electric Co, Baltimore, Md.



A portable bell-ringing device indicates energized 2,400-v circuits for Baltimore Gas & Electric Co. It may be used wherever a bare conductor and a ground are available. Over 100 indicators are used on the utility's system.

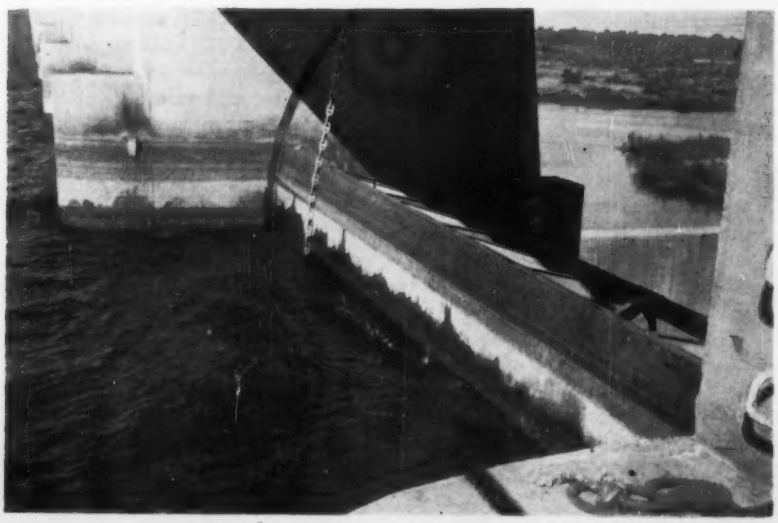
The device consists principally of an ac bell, transformer, current-limiting resistor and fuse mounted in a plastic case with carrying handle. A flexible lead with clip is provided for the necessary ground connection.

When connected to a live circuit and a ground, the bell will ring loud enough to be audible. In the event that the ground lead is accidentally detached and contacts the operator, the current-limiting resistor keeps the maximum current below 5 ma. This is not considered injurious over a short period of time.

The potential indicator will give reliable indications of voltages as low as 700 v. If it momentarily contacts an 8,000-v circuit, no damage will result; however, it is not intended for use at this voltage.

Operating condition of the indicator may be checked with a test device. This device consists principally of a small dc-ac converter coupled with a step-up transformer, suitable limiting resistor and switches. The device may be supplied from a 6-v or 12-v automobile ignition system.

Neoprene Protects Spillway Gates



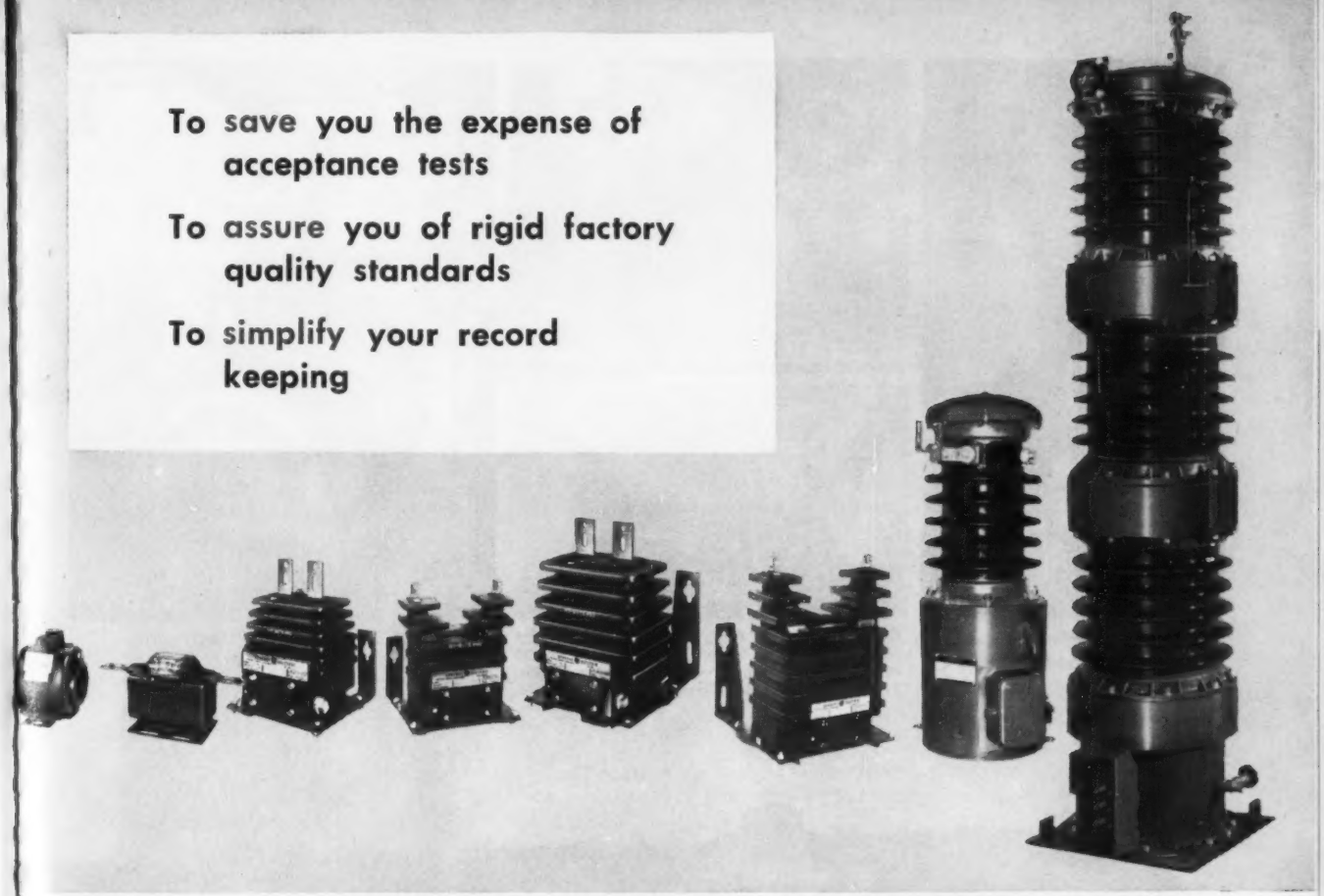
Four-year tests at South Carolina Public Service Authority's Santee Dam indicate that a neoprene coating effectively protects spillway gates longer than other coatings tested. The neoprene resists corrosive effects of the impounded water, which is slightly acidic, plus abrasion.

The application of the coating began with sandblasting of the surface, which was then coated with primer. The following morning another coat of primer was applied, plus five coats of liquid neoprene. A similar coating was applied to the control chain. The gate was air cured and closed with 8 to 14 ft of its height submerged.

To save you the expense of acceptance tests

To assure you of rigid factory quality standards

To simplify your record keeping



Now, from General Electric . . .

Test-certified instrument transformers—600 to 345,000 volts

Effective immediately, General Electric is extending its industry-accepted, test-certification program—which presently covers butyl-molded units—to oil-filled instrument transformers in the voltage ranges 25 kv and higher. A "certification of test" (see below) is now tagged to each oil-filled transformer you buy, certifying that it has passed rigid factory insulation and accuracy tests. Such test-certification—an industry "first" for General Electric—saves you the expense of acceptance tests and assures you of the high-quality standards governing the manufacture of all General Electric instrument transformers.

Your General Electric apparatus salesman has the complete test-certification story. For more information, write General Electric Company, Section 629-2, Schenectady 5, N. Y.

TYPE ES- 9 Company No. .....

Ratio 350/600 : 1 Mfr.'s Serial No. G 9362 53

Insul. Class. 69 KV ASA Accuracy Class- 0.3 W, X, Y, Z

Burden		Sec.	Conn.	Secondary (X Wdg.)		Tertiary (Y Wdg.)	
V.A.	P.F.	Volts	X or Y	R. C. F.	P. A. E.	R. C. F.	P. A. E.
0	—	115	1 - 3	.9997	-1.1	.9997	-1.1
0	—	115	1 - 3	.9997	-1.1	.9997	-1.1
200	1.0	115	1 - 3	1.0008	-3.7	1.0009	-4.1
0	—	67.08	2 - 3	.9998	-0.8	.9998	-0.8
200	1.0	67.08	2 - 3	1.0012	-2.6	1.0013	-3.6

Date 4/30/59 Tested by J. W. F.

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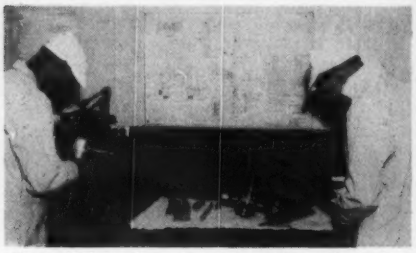
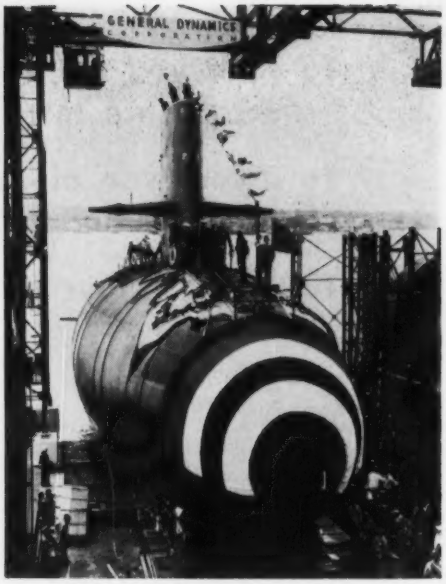
Pacific fleet submarine USS *Sargo.**

Extensive hydrostatic testing facilities at Copes-Vulcan include a hot test loop (shown above) that will pass up to 50-gpm at 2500 psig and 600 °F. Two cold test loops have 200-gpm and 800-gpm capacities.



Copes-Vulcan clean room is used for nuclear valve assembly. Air entering this sealed room is filtered mechanically—then by an electrostatic precipitator. Temperature and humidity are closely controlled.



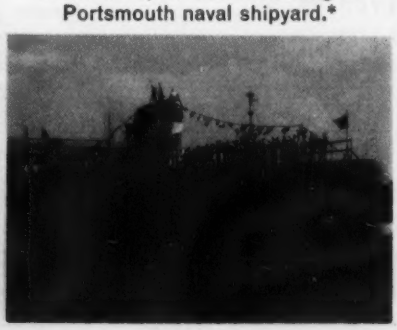
USS *Skipjack* launched at Groton, Connecticut.*

Key nuclear-powered projects

U.S. Navy's first nuclear powered aircraft carrier USS *Enterprise.**

Enrico Fermi Atomic Power Plant under construction near Monroe, Mich.

USS *Swordfish* after launching at Portsmouth naval shipyard.*



Launching of the USS *Seadragon*.*

USS *Skate*, the second United States submarine to reach the North Pole.*

use Copes-Vulcan nuclear valves

Pictured here are some of the nation's advanced projects using Copes-Vulcan's valves. To meet and exceed rigid standards demanded for nuclear service, Copes-Vulcan maintains highest quality control procedures.

Components, produced by advanced methods on modern machine tools, are thoroughly cleaned and assembled in sterile atmosphere. Where required, parts and completed valves are subjected to ultrasonic, radiographic, and mass spectrometer inspection. Flow tests may be conducted in either cold or hot test loops.

All this assures valves that meet such exacting requirements as leak tightness of stem and seat, resistance to corrosion, fail-safe operation, and remote maintenance.

The broad acceptance of Copes-Vulcan valves is proof of manufacturing skill and integrity in a field where precision is a necessity.

You are cordially invited to inspect Copes-Vulcan facilities.

*All ship illustrations are official U.S. Navy photographs.

COPES-VULCAN DIVISION
BLAW-KNOX COMPANY, ERIE 4, PA.

COPES VULCAN

BLAW-KNOX

Amines Boost Transformer Capability

E. W. TIPTON, Section Manager, Power Transformer Engineering, Westinghouse Electric Corp, Sharon, Pa.

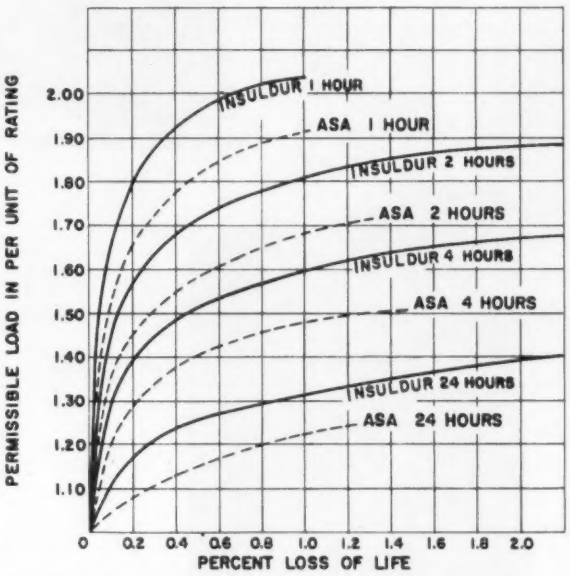
Small concentrations of certain amine compounds in transformer oil significantly improve aging characteristics of cellulose insulation. The improved aging characteristics permit extended operation at higher hot spot temperatures.

Ratings for the new units, calculated according to the American Standards Association guide, give permissible overloads about 10% higher than conventional transformers with no increase in loss of life.

The ASA "Guide for Loading Oil Immersed Distribution and Power Transformers" relates time-temperature to insulation life. Loads are calculated in terms of winding temperatures. The data in the Guide are based largely on deterioration as indicated in the tensile strength of the insulation. Thus higher temperature tolerance in the insulating material converts directly to higher capability.

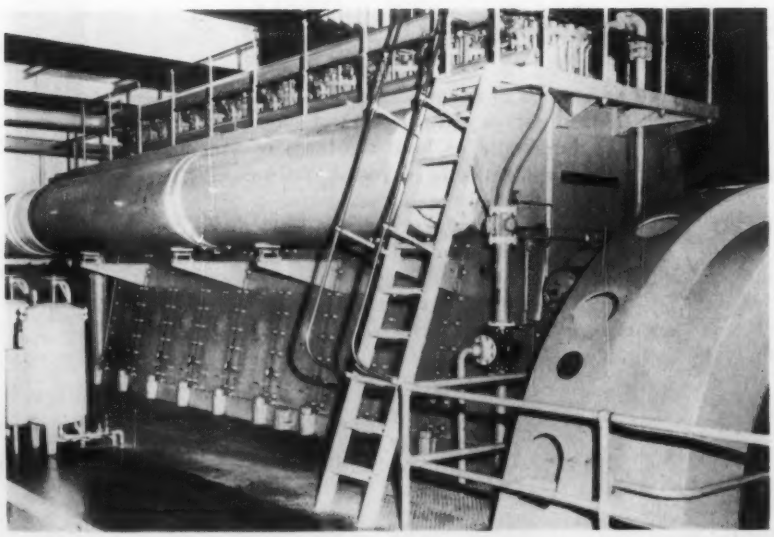
Temperature tolerance of the new Insuldur insulation system was established by tests conducted on two small sealed transformers first placed in service in November, 1949. The transformers are still in operation. One, containing an amine compound, was loaded to produce a hot spot temperature of 125C for about 50% of the time on a weekly basis. The other, containing no amines, was loaded to a 115C hot spot temperature.

Periodically, samples of insulation were removed from the transformer and tested for tensile strength. Samples were taken from extra coils in series with the winding, located in hot oil at the top of the transformer. Aging was slower in the amine stabilized transformer though it was operated at 10C higher temperature.



PER-UNIT LOADS are higher for same loss of life when temperature tolerance of Insuldur system is evaluated by ASA method. Dashed lines show conventional values

Diesel Goes on Base-Load Operation



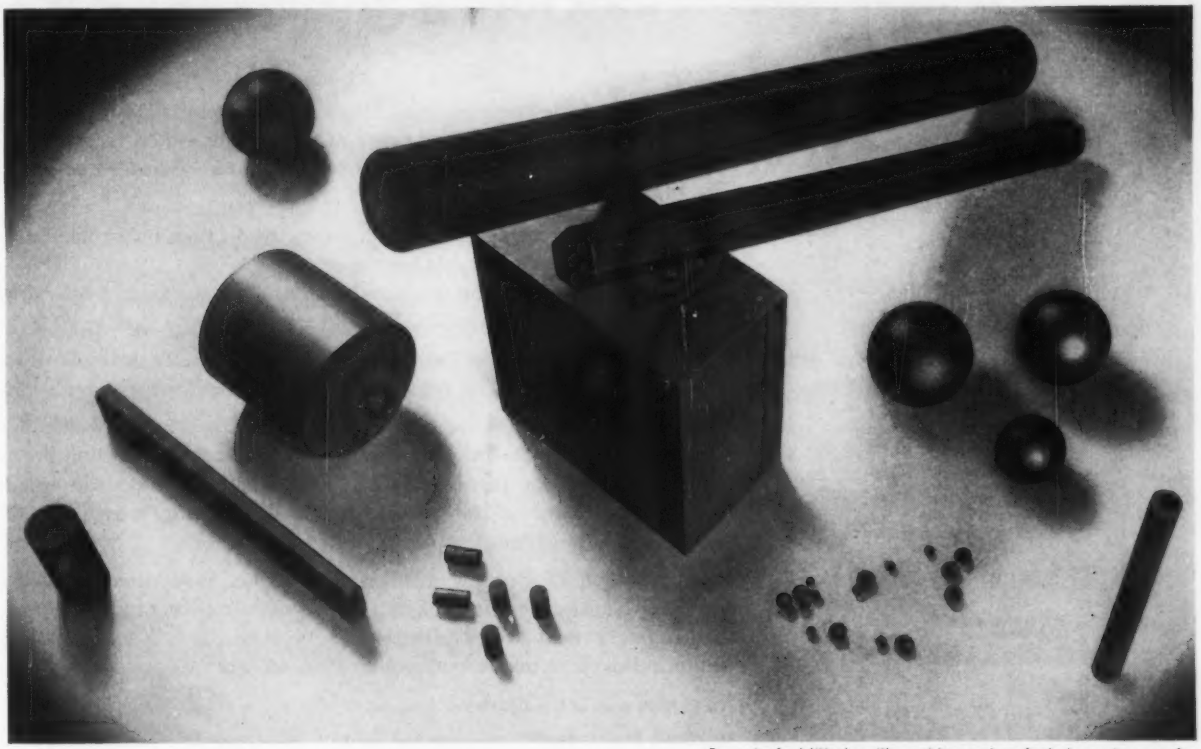
Since Nebraska City, Neb., placed a 4,350-hp Duafuel Nordberg diesel engine generator in service in July, 1958, it has been the workhorse of the city's system. On the line 86.5% of the time, it has generated over 8 million kwhr, according to Nebraska University professor K. N. Newhouse. Heat rate is below 10,200 Btu per kwhr.

The engine can be operated on diesel fuel, natural gas, or a combination. As local fuel costs favor gas, a minimum of oil is used.

Although the plant is only a few hundred feet from the Missouri River, cooling towers are used because of operating difficulties due to sand bars, contamination and variable river water temperatures.

NATIONAL NUCLEAR GRAPHITE...

TRADE-MARK



Some typical "National" graphite nuclear fuel element concepts.

Graphite's unique properties conform to the many requirements for high temperature fuel elements

- High temperature strength.
- High thermal conductivity.
- Resistance to thermal shock.
- Dimensional stability.
- No practical melting point — safety.
- Low neutron absorption — neutron economy.
- Neutron moderation.
- Resistance to radiation damage.
- Flexibility of design.
- Simplified reprocessing of spent elements.

FUEL ELEMENT CONCEPTS FOR HIGH TEMPERATURE REACTORS

Today, there is intense interest in obtaining nuclear heat at temperatures above 800-900°C. To accomplish these high temperatures, industry must develop a reliable fuel element. National Carbon Company has undertaken an extensive research and development program to help meet this need. Illustrated above are a number of graphite matrix nuclear fuel element conceptual designs for high temperature reactors.

Dispersions of fissionable and fertile materials — uranium and thorium oxides, or carbides — in a graphite matrix will permit operation of reactors at higher temperatures, higher specific power, high burn-up, low fuel fabrication cost and excellent neutron economy. Spent fuel processing may be considerably simplified when graphite base fuel materials are used.

National Carbon Company is presently conducting extensive research to further develop impervious graphite and effective impervious coatings for retaining fission products and preventing oxidation. Remember . . . no other material today has so many useful nuclear properties as does "National" Nuclear Graphite.

Write today for 8-Page Brochure "'National' Nuclear Graphite"

UNION CARBIDE

"National" and "Union Carbide" are registered trade-marks of Union Carbide Corporation

NATIONAL CARBON COMPANY • **Division of Union Carbide Corporation** • ***30 East 42nd Street, New York 17, N. Y.***

OFFICES: Atlanta, Chicago, Dallas, Houston, Kansas City, Los Angeles, New York, Pittsburgh, San Francisco • **CANADA:** Union Carbide Canada Limited, Toronto

Tough Formex† insulation being extended to G-E

Now General Electric's Formex film insulation, proved through years of use to be superior to other types of turn insulation on transformers up to 34.5 kv, is being extended to 69-kv medium* transformers. Here are the facts from recent accelerated life tests . . .

- **FORMEX** insulation lasts four times longer than paper insulation at temperatures suitable for paper (105C).
- **FORMEX** insulation is a satisfactory turn insulation at operating temperatures at least 10 C higher than paper.
- **FORMEX**, after partial dielectric deterioration, will regain insulation strength after return to equilibrium moisture conditions.

Since turn insulation is adjacent to wire at the hottest part of a transformer, it is the most critical of transformer insulations. The use of Formex for turn insulation instead of cellulosic insulations effectively eliminates the largest moisture-producing source in G-E medium transformers.

Application of Formex insulation to higher insulation classes of medium transformers is part of General Electric's continuing efforts to provide even better products. Recent evaluation of experimental units indicates superior performance on all Formex insulated 69-kv

†Reg. Trade-mark of General Electric Company.

*MEDIUM TRANSFORMERS (including RM—repetitive manufacture) 501 to 7500 kva, 69 kv and below.

WINDING FORMEX

69-kv medium transformers

medium transformers. As a result, Formex insulation will be in production on 69-kv G-E medium transformers by the end of 1959.

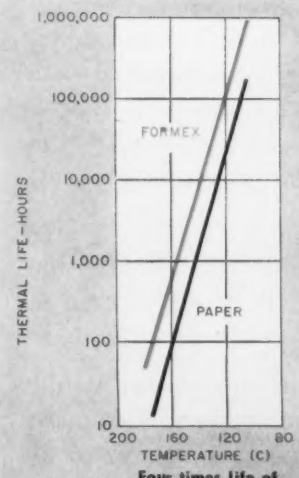
Product leadership is just part of our story. General Electric medium transformers are certified to deliver **full value** for your transformer dollar . . . in terms of superior products . . . plus faster order handling and shipment . . . plus complete service before, during and after installation. When deciding on your next medium transformer, examine the **complete "package"** offered by General Electric. When you do, we're confident that you'll recognize General Electric superiority.

Your G-E Apparatus Sales Engineer can show you all the ways you get full value for your transformer dollar from General Electric. Ask him today for details on the Certified Full-value Transformer Program. General Electric Co., Schenectady 5, N. Y. 416-26

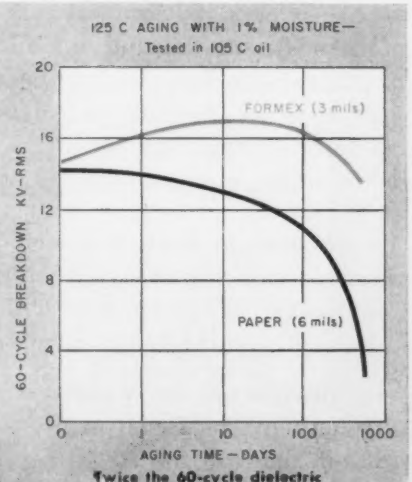
Progress Is Our Most Important Product

GENERAL ELECTRIC

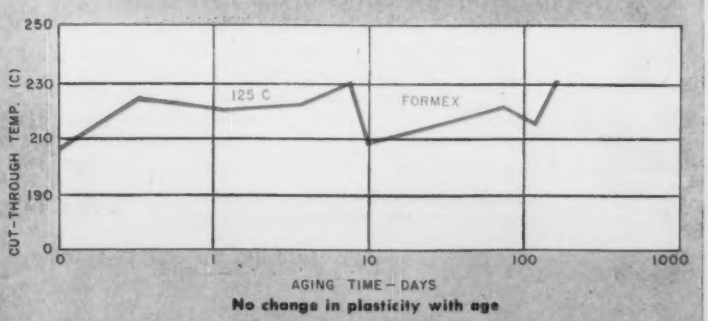
AGING CHARACTERISTICS



Four times life of paper insulation at 105C

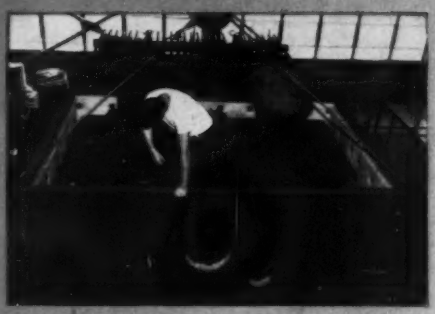


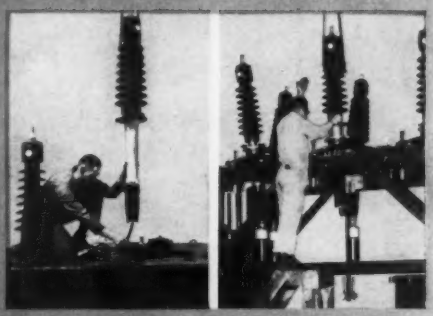
Twice the 60-cycle dielectric strength of paper



No change in plasticity with age

FULL VALUE FOR YOUR TRANSFORMER DOLLAR





SUPERIOR DESIGN, FEATURES, AND PERFORMANCE of General Electric transformers is typified by pre-fabricated enclosure (above) and interchangeable transformer-breaker bushings (below).

FASTER SHIPMENT through rapid processing of orders . . . computer design capability . . . repetitive manufacturing facilities.

COMPLETE SERVICE . . . application and systems engineers . . . installation engineers . . . 50 conveniently located service shops.

Procurement & Products

OUTLOOK ▶ **General business outlook is rosy,** says McGraw-Hill Department of Economics in its June communique. You will have to scratch some to find things worth worrying about during these summer months, but if you insist, here are a couple of items that will have a bearing on utility procurement:

Inventories—Industry has been accumulating these at the annual rate of $6 billion during the first quarter and the second quarter figure may run as high as $7.5 billion. Much of this is due to the imminence of a steel strike and the potentiality for labor troubles in the nonferrous and rubber industries as well. Slackening of inventory formation during summer months will take some of the steam out of the business rise, but effect will be temporary.

Housing—Recent rate of 1.4 million units a year probably can't be sustained, but drop back to 1.2 million will still keep new distribution construction at a relatively high level.

FUEL ▶ **Coal associations blast biggest customer** for what they call "destructive" purchasing practices. TVA is the target of the associations' blast charging that the agency has contributed more to the degradation of the coal industry's economic status than any other single factor.

COPPER **Copper buying spree is definitely at an end.** And copper outlook is obscured for balance of '59 by accumulation of copper stock abroad, possibility of major strikes here and in Chile. In face of union contracts expiring within two weeks, fabricators have displayed little interest in placing orders for July or August. Industry has moved most of its copper to fabricator plants as hedge against possible strikes, present shortage problem if third quarter buying boom occurs.

STEEL ▶ **Higher steel prices brought about by agreement** either before or after a strike could very well bring swift and arbitrary government action. President Eisenhower has indicated he will take action to head off another spiral of inflation if he can find appropriate means to do so.

Here's a tip on purchases of heavy construction equipment: A study released this month by the Departments of Labor and Commerce shows that rises in the iron and steel price index generally precede upturns in the index for construction machinery and equipment. The lag in 1955, '56, and '57 ran from one to three months.

News of Manufacturers ..... page 100

New Equipment ..... page 108

Readers Service ..... page 112

USE SOUTHWIRE SINGLE SOURCE SERVICE

A quick glance at Southwire's list of products shows how you can save time, trouble, and money.

You'll find it a simple matter to deal with one source—one order, one bill, one check. And when you order from Southwire, you get Southwire service—the extra that means so much, but costs no more.

A phone call right now will bring our catalog, prices, delivery schedules to your desk.

ALUMINUM • COPPER • STEEL STRAND

- Bare and Weatherproof Copper and Aluminum Line Wire
- Neoprene, Polyethylene, and VWP (Vinyl) Weatherproof Copper, Aluminum and Triplex
- U.R.C. (DBWP, TBWP) Copper
- Copperweld® Conductors
- Copper and Aluminum Building Wire
- ACSR and All Aluminum Cable
- Galvanized Steel Guy Strand and Static Wire
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• ALSO FABRICATORS OF COPPER AND ALUMINUM FOR WIRE AND CABLE MANUFACTURERS

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SOUTHWIRE serves the world

STEP
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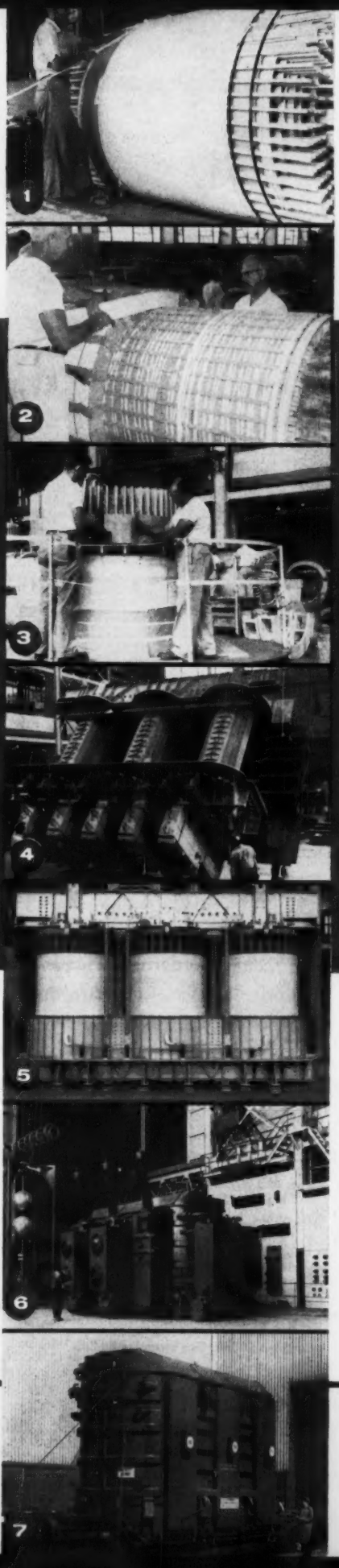
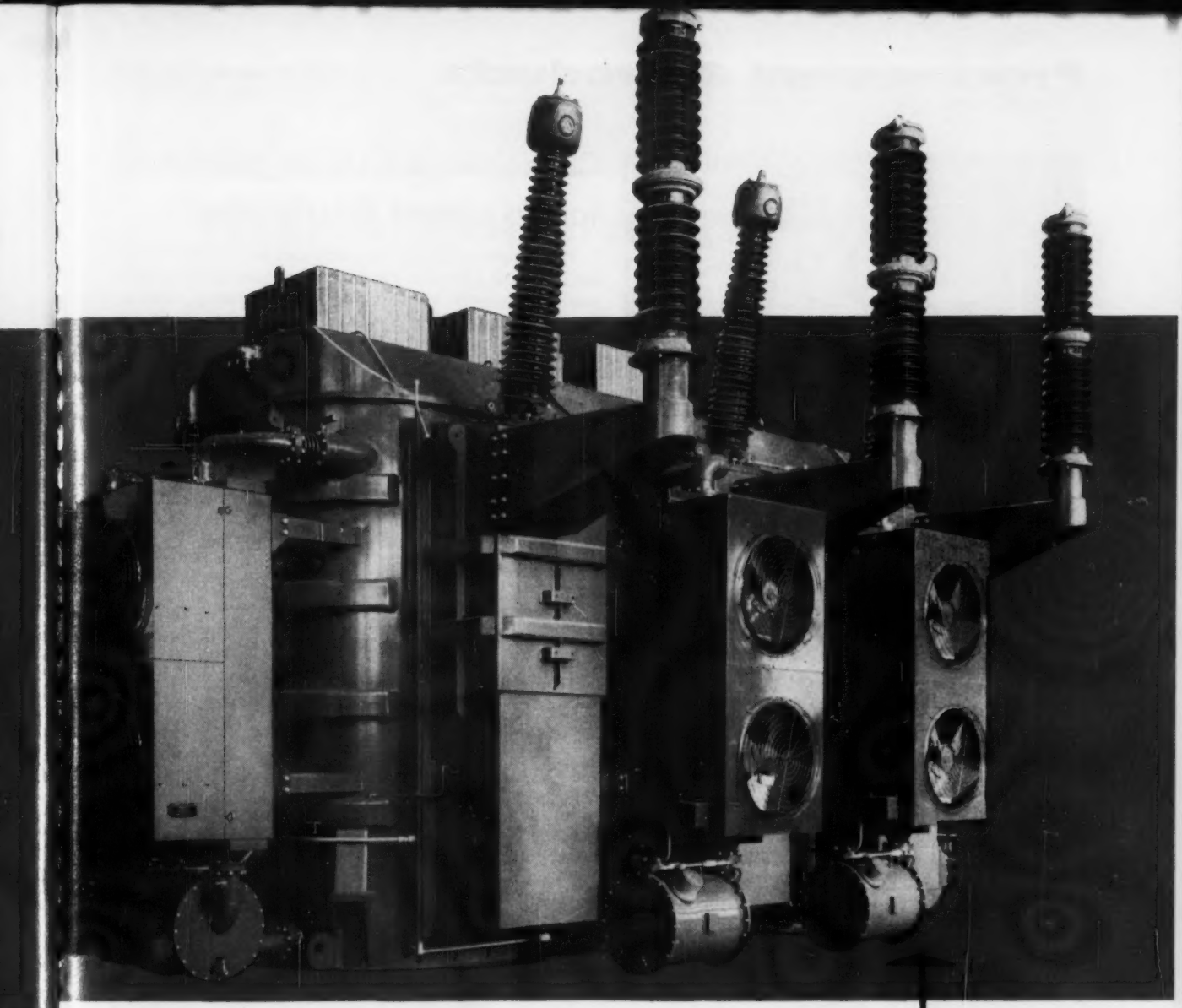
217,000 KVA, 230 KV TRANSFORMER

for POTOMAC ELECTRIC POWER COMPANY'S DICKERSON GENERATING PLANT



1. Winding High Voltage Coil
2. Winding Low Voltage Coil
3. Flanging High Voltage Coil
4. Raising Stacked Core
5. Low Voltage Side of Core-and-Coil Assembly
6. Testing Completed Transformer
7. Shipping Transformer



This power transformer will be installed at Potomac Electric Power Company's new 55 million dollar Dickerson Generating Station, located on the Potomac River in Upper Montgomery County, Maryland. The unit is a 217,000 KVA, three phase, type FOA, transformer having a high voltage rating of 234,000 Grd. Y/135,000 volts, with 2-2½% no-load taps above and below normal and a low voltage rating of 13,500 volts delta.

The transformer is connected through isolated phase bus duct to Unit #1, a 175,000 KW generator, which is the largest generating unit on the PEPCO system. The generated voltage of 13,500 volts will be stepped-up to 230 KV for transmisson. This transformer is an important link in the PEPCO system, and it exemplifies Moloney's ability to build large power transformers of any type or rating to customer's exact specifications.

For additional information on the engineering ability and facilities which make Moloney particularly well-qualified to build large power transformers, contact your Moloney representative. Specify Moloney Transformers . . . All Along The Line.

ME59-5

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MOLONEY ELECTRIC COMPANY

Transformers For Utilities, Industry, and Electronic Applications

MOLONEY ELECTRIC

Capacitors Go Underground for Overhead Distribution

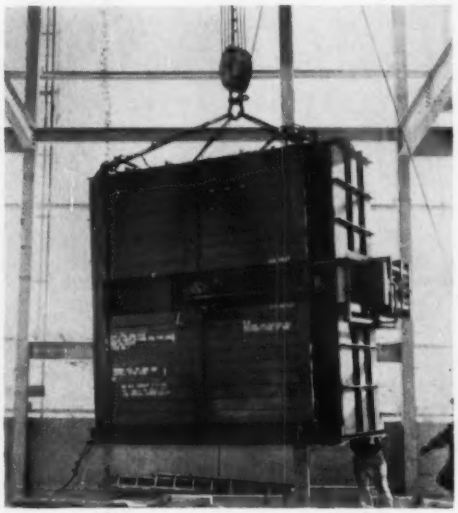
Philadelphia Electric Co personnel are shown lowering 300-kvar capacitor equipment into curb-side ground vaults to supply kilovars for the company's 4160-v overhead distribution system. Underground location was chosen to save space on power poles, 100-kvar capacitors to eliminate interconnection of units.

Designed by General Electric for this application, each pole-side installation has three 100-kvar, 2400-v capacitors, one for each phase, wye-connected and mounted on a heavy-gauge aluminum rack. Capacitor cases and terminal boxes are made of stainless steel, hermetically sealed against moisture. Air circulation in the grate-covered vaults is sufficient to dissipate the capacitors' waste heat. Vaults are gravel-lined at bottom, with sides of treated lumber.

Large Packaged Preheater Installed to Cut Fuel Cost

Preheater is hoisted into the power station being built by the Town of Braintree, Mass., where it will be used on a 130,000-lb-per-hr pressurized oil-fired boiler.

Factory-assembled by the Air Preheater Corp., the preheater requires only ducts for combustion air flow and hot flue gas flow. It will receive air at 80F, preheat it to about 500 F. It is expected the preheater will pay for itself through economy of operation in less than 2 years.



Unique Tube System

Intricate tube system of the Enrico Fermi Atomic Power Plant is explained, using scale model, by P. S. Otten of Griscom-Russell, to Southern California Edison engineers A. C. Werden and James Henderson (center), as G-R district manager J. W. Hagen looks on.

The serpentine, involute, and trombone-nested design of the 18 miles of tube winding through the steam generators can be adapted for similar heat exchanger designs for organic-moderated and gas-cooled nuclear reactors.

(*More News of Manufacturers, p* 102)

VICTOR suspensions

make dollars and sense

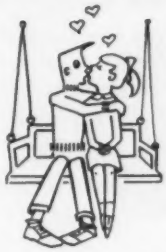
WHY SPECIFY VICTOR?

When you're buying insulators for your lines, don't go about it blindly. Buy the Suspension with an enviable reputation for performance . . . made by a company that's famous for service at the factory and in the field. VICTOR Suspension Insulators are used by many of the nation's foremost utilities on HV and EHV lines. And why not? They are premium products, yet they cost no more than others. Remember—insulators have been made at VICTOR since 1893. To VICTOR, insulator-making is a science. Scientific methods together with meticulous attention to detail have made VICTOR insulators the finest that are available. Put up VICTOR Suspensions today and the chances are you won't ever replace them . . . they will last that long! It's smart buying to buy VICTOR. Makes dollars for you . . . and sense, too.

AIR-CONDITIONED COMFORT

Yes, sir, VICTOR insulators are treated better than most people! We even give them temperature-humidity controlled atmosphere to breathe while the cement that holds cap, shell and pin together, sets and hardens. Reason for such pampering is to prevent cemented assemblies from losing moisture too rapidly . . . permitting them to set properly and attain greatest bonding strength. It's a small detail in the entire VICTOR manufacturing procedure. But, a lot of small details like this result in better Suspensions . . . VICTOR Suspensions.

MAKING SURE A HOT LINE WON'T GET COLD



The *Purified* Porcelain VICTOR uses in all its suspension insulators is your best assurance against the hazards of weather. This finest insulator porcelain ever made has unequalled ability to withstand stress and strains due to ice, snow and high winds. They endure thermal variations way above EEI-NEMA standards. They make dollars and sense for any power man.

WE SOCK 'EM WITH A HAMMER!

If there were a Society for the Prevention of Cruelty to Insulators, we'd be in trouble most of the time! There's no arguing the fact . . . we treat 'em rough when it comes to testing them for impact. In our test laboratories, our quality control procedure subjects VICTOR Suspensions to impact steps far in excess of EEI-NEMA standards by means of a hammer of known weight falling at predetermined heights and striking the outer edge of the insulator shell. These rather drastic tests do destroy quite a few insulators. That's bad! But they do make sure that the VICTOR Suspensions you get have greater resistance to impact than any other suspension insulators you can buy. That's good!

DO YOU KNOW THAT . . .

- VICTOR's plant began producing wet process porcelain in 1893?
- VICTOR's Craftsmen have a total of more years of insulator-making experience than those of any other plant in the industry?
- VICTOR was the first to use demineralized water for all processing?
- VICTOR pioneered the use of infrared drying of insulators?
- VICTOR was among the first to use silicon carbide kiln furniture?
- VICTOR pioneered the use of modern tunnel kilns equipped for recirculation of kiln gases?
- VICTOR was the first to use American clays exclusively?

For full information on VICTOR Suspension Insulators, write I-T-E Circuit Breaker Company, Victor Insulators Division, Victor, N.Y.

VICTOR NO. 900
Suspension Insulator

I-T-E CIRCUIT BREAKER COMPANY
VICTOR INSULATORS DIVISION

I wish we had more time
and personnel to prepare
for this rate case!

Your staff is
overloaded now.
Call in the specialists and
let them carry the peak load.
HOW ABOUT PIONEER?

GIVE YOUR NON-ROUTINE
OPERATIONS TO PIONEER

Design and Consulting Engineering Services

Pioneer has specialized in designing power plants for 57 years. It designs fossil fuel, hydro and atomic plants. It forecasts load growth, selects sites, purchases and expedites equipment and supervises construction. Pioneer's other services include substation, transmission and distribution studies and design.

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Pioneer offers services in all phases of Federal, State and Local regulation including rate base, depreciation analysis, cost of service studies, market analysis, certificate proceedings and rate of return.

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Pioneer's services in corporate matters include business and management engineering advice, financial, accounting, tax counsel, insurance, and pension planning. It maintains a complete stock transfer, ledger and dividend disbursement service.

NEW!

On your letterhead, write for 40-page booklet, "Pioneering New Horizons in Power". Describes, illustrates Pioneer's engineering services, and corporate services, from financing to operation.

57 YEARS

Pioneer Service & Engineering Co.

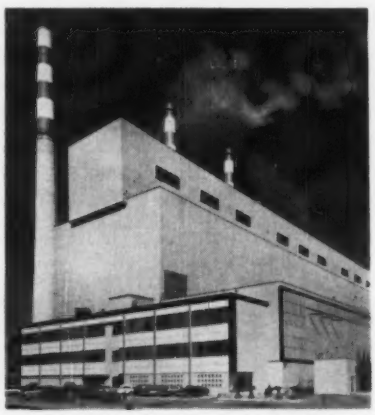
231 South La Salle Street
Chicago 4, Illinois

Carrier Corp to Design Thermoelectric Heat Pump

Design studies to test the feasibility of thermoelectric heating and cooling in shipboard air conditioning will be undertaken by Carrier Corp under a Navy contract.

An 18-month program contemplates preliminary design and analysis. Successful completion, says Carrier, could lead to large-scale development of thermoelectric heat pumps containing no moving parts. As an indication of the size requirements, Carrier points out that conventional systems for medium-size ships range from 160 to 300 tons in cooling capacity.

Thermoelectric heat pumps produce cooling and heating directly from the action of an electric current on certain combinations of materials. Thus they eliminate noise of refrigerating compressors or pumps used in present-day air conditioning.



Porcelain on Aluminum Sheathes Allen Station

The new Thomas H. Allen Electric Generating Station at Memphis, Tenn., sets a new trend in aesthetics for power plants. Sheathing the structure are more than 200,000 lb of porcelain enamel on aluminum, ranging from insulated panels to a specially designed grid-wall office section. All aluminum for the project was supplied by Aluminum Co of America.

Panels only 3½-in. thick are used for the walls of the main plant. Forming both the interior and ex-

(*Continued on page* 106)

experience

keeps BICC *in the lead*

Being the World's greatest cablemakers is not just a matter of size.
It's also, generally speaking, a case of knowing more than the other guy.
The experience gained from making BICC cables and accessories for every electrical purpose has helped us pioneer many developments in our field.

This 138 kV submarine cable had to be 16 miles long *–unjointed!*

The power link between the British Columbia mainland and Vancouver Island required more than 133 miles of 138kV single-conductor submarine cable, including seven 16 mile lengths — each without a single joint. Making such unjointed lengths of cable was considered to be 'impossible' in the electrical world. But BICC made and laid them with conspicuous success. Altogether some $10,000,000 of power cable contracts have been placed with BICC by the British Columbia Electric Company Ltd.

D.S.O. FOR ECONOMY

The Ductless Shaped-conductor Oil-filled cable is BICC's latest development in 33kV transmission. Dispensing with fillers and built-in ducts, it costs less than conventional cables of equal duty.

CABLES FOR THE FIRST NUCLEAR POWER STATION

BICC supplied cables and accessories for Calder Hall, England, the first nuclear power station in commercial operation. The cables include specially designed types resistant to intense radiation and heat, for operating the fuel charging and discharging grabs.

330,000 VOLT CABLE FOR KARIBA

The Kariba dam is being built on the Zambesi river to provide hydro-electric power for Central Africa.

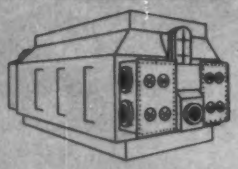
Transmission equipment for this project is being manufactured by BICC. Altogether orders for this company total some ten million dollars and include a specially designed 330,000 volt single-conductor oil-filled cable — at present being manufactured — which will connect the underground power house to the overhead transmission lines. This will be the highest voltage cable ever installed in Africa.

BICC the World's largest cablemakers

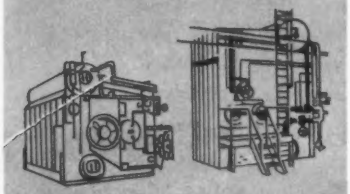
BRITISH INSULATED CALLENDER'S CABLES LIMITED
Technical Representative in U.S.A., Arthur F. Coventry, 11 West 42nd Street, Suite 442, New York 36, N.Y.

Power Plant Products

HEAT ENGINEERED BY FW

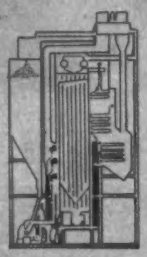


CONDENSERS and HEATERS—Condensers custom designed for individual plant requirements. All-welded high and low pressure feedwater heaters.

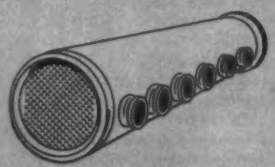


PACKAGED and FIELD-ERECTED BOILERS—Compact, economical, standardized units in capacities from 10,000 to 450,000 lb/hr oil, gas or pulverized coal fired.

LARGE STEAM GENERATORS—Designed to meet all requirements for Central Station or Industrial power plants, in single- or twin-furnace designs, with or without reheat or dual circulation.



COOLING TOWERS—Induced draft counter flow towers of all-redwood construction for maximum dependability and long service.



NUCLEAR COMPONENTS—Heat exchangers, steam generators, pressurizers, reactor vessels, separately-fired superheaters for stationary and marine power plants.

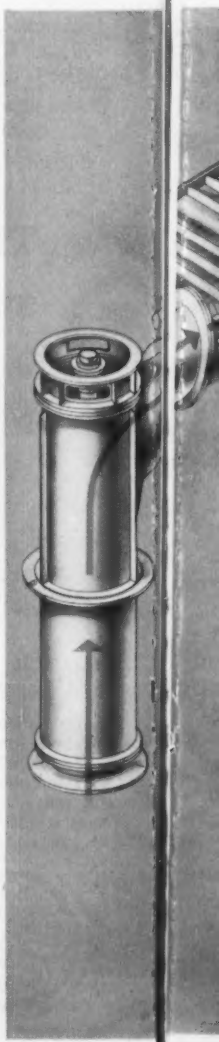
PULVERIZED FUEL SYSTEMS—Completely engineered systems utilizing FW ball mill or MB planetary roll and table pulverizers.

HEAT ENGINEERING

SIMPLIFIES LAYOUT and

WITH NEW SINGLE-PASS,

Compact shells use economical short tubes, eliminate two waterboxes, simplify valving. Balanced back pressure and built-in backwashing system offer further advantages for Alabama Power Company's Barry Steam Plant, Unit No. 3.



Problem: Alabama Power Company and Southern Services, Inc., Engineers, specified that the dual exhausts of the 225,000 kw turbine be handled with condenser tubes at right angles to the turbine shafts —in the tight confines of a plant extension for Barry Steam Plant, Unit No. 3.

Solution: Heat Engineering by Foster Wheeler

By application of the established principles of Foster Wheeler condenser design, a most economical arrangement for a twin bottom-exhaust turbo-generator set with tubes at right angles to the turbine shafts was provided. It features short tube lengths, complete backwashing and a minimum number of waterboxes for a twin-shell design.

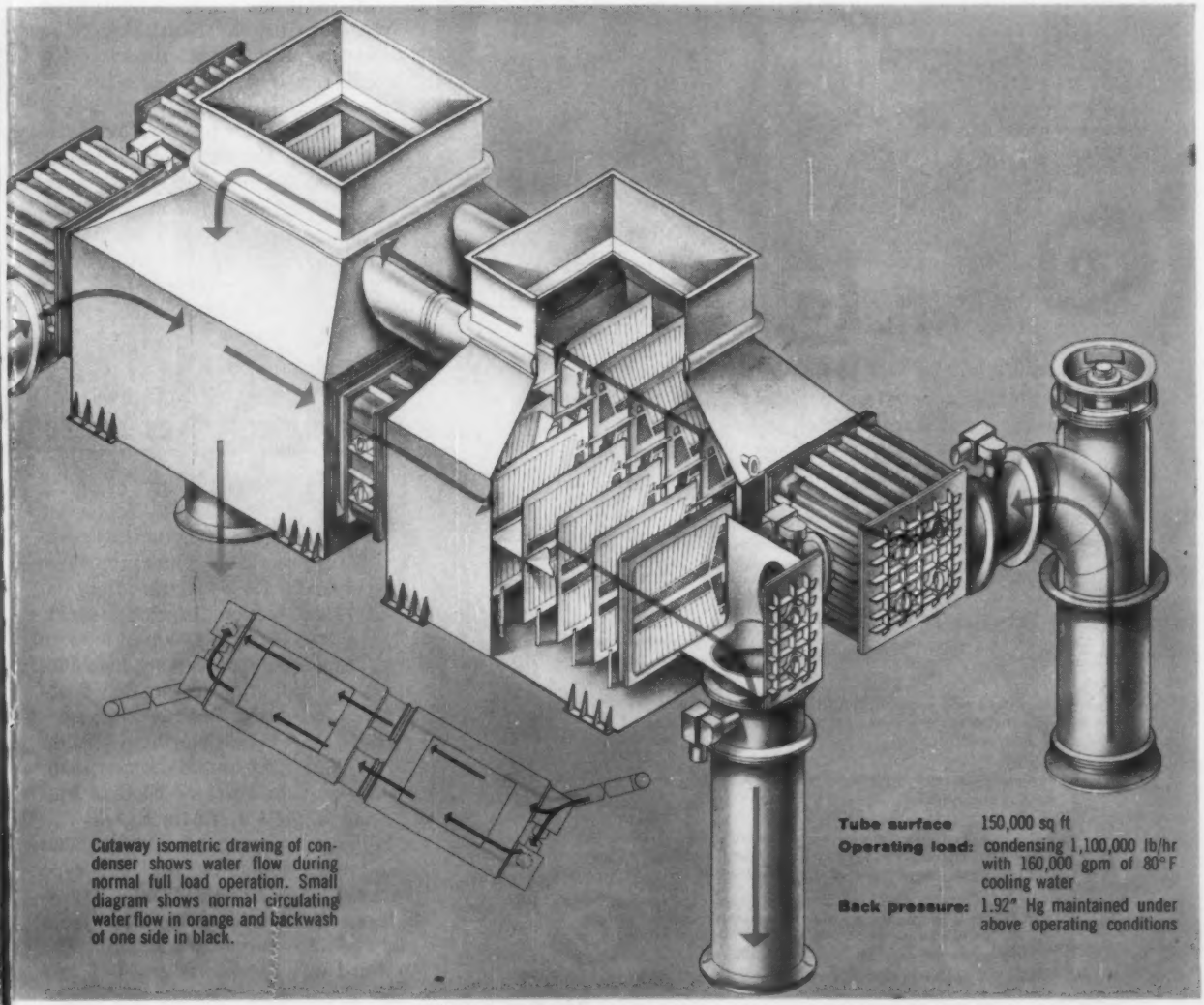
Backwashing of the tube sheets is obtained with only six valves, two of which are the normal circulating pump shut-off valves. This valving arrangement also allows the complete condenser to be operated at light loads with only one circulating pump.

In design advances such as this, you see Heat Engineering at work. This is the concept you can expect—combining new and original ideas with proved engineering principles—when Foster Wheeler serves you. *Foster Wheeler Corporation, 666 Fifth Avenue, New York 19, New York.*

BY FOSTER WHEELER

REDUCES CONDENSER COSTS

COUNTER-FLOW DESIGN



Cutaway isometric drawing of condenser shows water flow during normal full load operation. Small diagram shows normal circulating water flow in orange and backwash of one side in black.

Tube surface 150,000 sq ft

Operating load: condensing 1,100,000 lb/hr with 160,000 gpm of 80°F cooling water

Back pressure: 1.92" Hg maintained under above operating conditions

FOSTER WHEELER

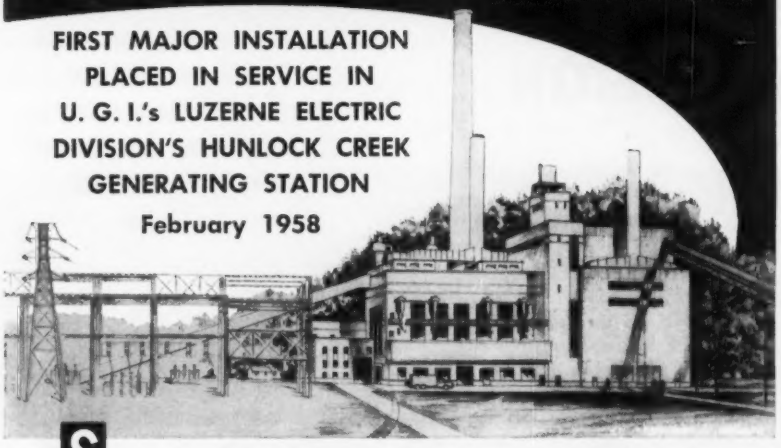
NEW YORK • LONDON • PARIS • ST. CATHARINES, ONT.

*GTC PROVED RELIABILITY

IN-PLANT COMMUNICATION SYSTEM

FIRST MAJOR INSTALLATION PLACED IN SERVICE IN U. G. I.'s LUZERNE ELECTRIC DIVISION'S HUNLOCK CREEK GENERATING STATION

February 1958



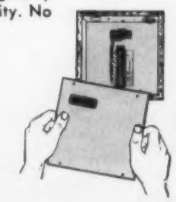
Since that time, the GTC system delivered constant, uninterrupted service. New plant unit will include extension.

This installation, as well as thousands of GTC units that have been installed in power stations and industrial plants throughout the United States since, have definitely established the superiority and reliability of GTC in industrial voice communications.

Features contributing to GTC's acceptance and reliability are:

1. Provides swift and sure voice communication even in adverse environmental conditions, such as extremes of temperature and noise.

2. All amplifiers are "plug-in" contributing greatly to ease of installation and maintainability. No central equipment is required.



3. Long-life transistors and rugged, industrial type components are used throughout. No vacuum tubes or "entertainment" type components are employed.

4. Inconvenience and expense of vacuum tube replacement is eliminated.

5. Design allows expansion of system from "very small" to "very large" by simple addition of units where required.

6. Ultra simple wiring plan (no shielded cables) and unitized equipment with integral terminal facilities make for easy low cost installation.

*Gai-Tronics Transistorized Communications is an effective, economical industrial communication system designed to provide swift and sure voice communications regardless of distance or surrounding noise conditions.

GAI-TRONICS CORPORATION
Dept. A
READING, PENNA.
A SUBSIDIARY OF GILBERT ASSOCIATES, INC.
ENGINEERS AND CONSULTANTS

GTC is extremely flexible in application. Write today for a copy of our completely illustrated, descriptive booklet and name of nearest representative.

Allen Station

(*Continued from page* 102)

terior finish, the panels have a glass fiber core. The outer aluminum skin is finished in green porcelain enamel.

The office section features a grid-wall of insulated aluminum panels coated with a porcelain finish in a yellow hue.

North American, Foster Wheeler Call Off Merger

Plans for the acquisition of Foster Wheeler Corp by North American Aviation, Inc, were recently discontinued. The change of plans was announced jointly by W. L. Martwick, president of Foster Wheeler, and J. L. Atwood, president of North American.

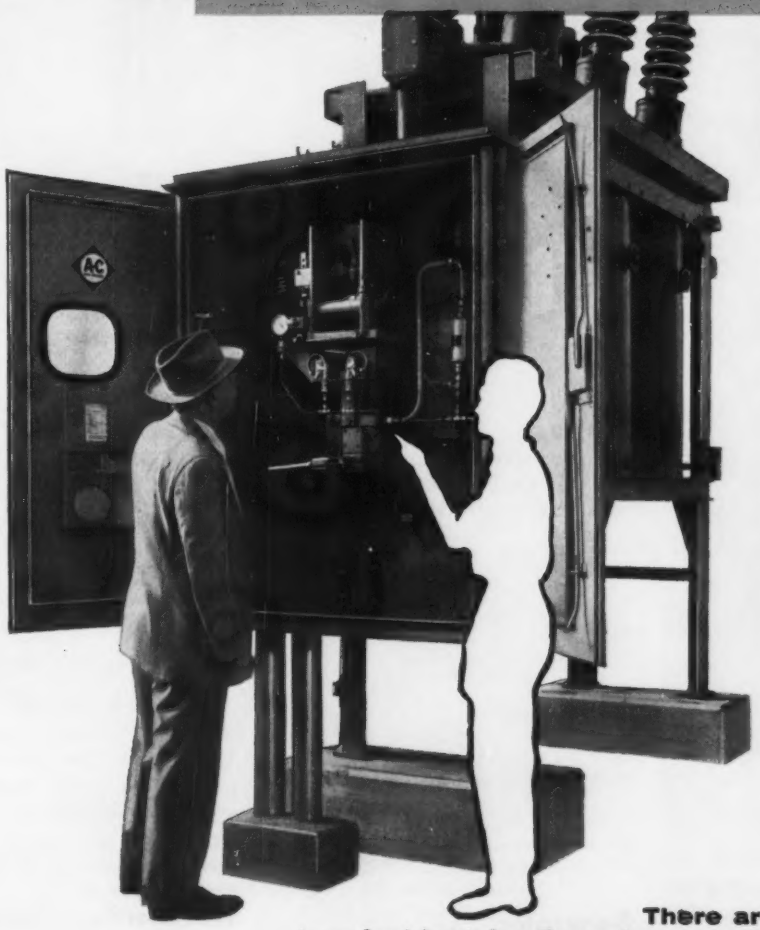
"Detailed studies of the two companies' operations . . . resulted in the conclusion that the mutual benefits originally expected from the merger would not be realized," the companies said.

MANUFACTURERS BRIEFS

Nineteen electric utility engineers recently completed a four-week course in digital computers at **General Electric.** The course, fourth to be given by GE's electric utility engineering section in Schenectady, deals with the application of modern electronic data processing machines in the solution of engineering problems . . . About 40 industrial sales engineers from Northern States Power recently toured the new manufacturing facilities of **Electric Machinery Mfg Co** at Minneapolis . . . For development of a corrugated shipping container for pole-type transformers, **Pennsylvania Transformer** received a gold award from the Fibre Box Association. The award was given jointly to P-T and to Kress Box Div of St. Regis Paper . . . **Philco** recently broke ground for its multi-million dollar Transac computer center at Willow Grove, Pa. The 200,000-sq-ft facility will contain national sales offices and research, engineering and manufacturing facilities for producing the Transac S-2000 large-scale electronic data processing system.

ALLIS-CHALMERS modern line for '59

Look at the NUTS and BOLTS



There are no short cuts to modernizing today. Few systems are so completely outmoded that the steps needed to modernize them are completely obvious.

However, as equipment manufacturers, we at Allis-Chalmers see several areas which offer considerable potential for improvement among a wide group of utilities. One of these is what we call "Looking at the nuts and bolts."

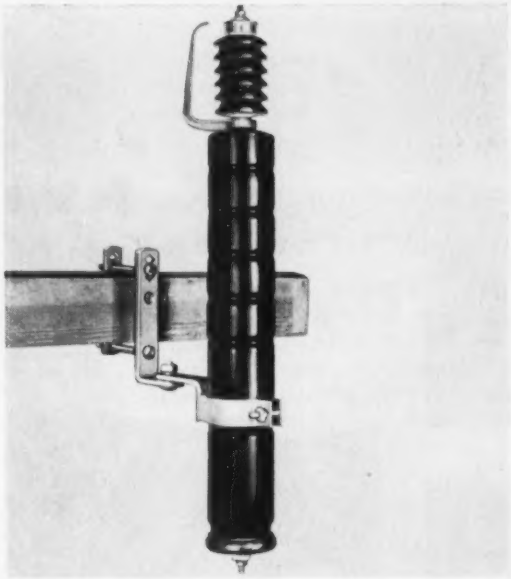
Functionally, electrical equipment is standard today, but there's still room for the designer's genius. Looking at the nuts and bolts is one way you have of getting the best... the most modern... the equipment with the most unusual and helpful features.

A-5993-E **ALLIS-CHALMERS**

On the following pages are items of Allis-Chalmers equipment we recommend for the design "extras" that can help your company stay modern.

(For further information refer to Reader Service Card on page 112)

Lightning Arresters . . .



. . . in ratings of 12, 15 and 18 kv are now being offered. The heavy-duty, open-gap, valve-type arresters are designed for use with system voltages of 12-kv delta through 14.4/24.9-kv wye and to augment previously announced ratings up through 10 kv. The new arresters are designated Type TX-4 for mounting on crossarm, pole or wall and Type T-4 for mounting on transformer or regulator. They have an external gap in series with the valve element and resistance-shunted internal gap structure.

Line Material Industries, McGraw-Edison Co, Milwaukee 1, Wis.

Ventilating Fans . . .

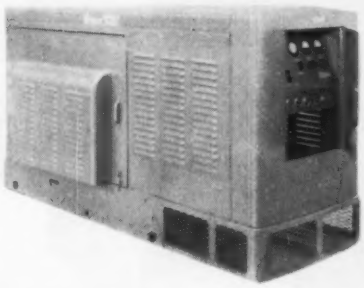
. . . in three new models provide ventilation up to 11,000 cfm. The new Type L-CRF airfoil centrifugal fans are specially designed for high-capacity duct and flue exhaust applications. Units have a weather-tight housing of heavy-gauge spun steel. The roof is aluminum.

Ilg Electric Ventilating Co, 2850 N Pulaski Rd, Chicago 41, Ill.

Transmission . . .

. . . in 5 to 10 hp class has three speeds forward and one in reverse. The model 31A13-1 transmission is equipped with a master clutch controlling engagement of speeds plus an auxiliary clutch for control of the auxiliary output shaft. Variations of the transmission can be made for specific applications.

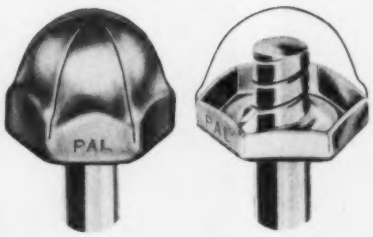
Adams Engineering Co, 31711 Solon Rd, Solon, Ohio.



Generator . . .

. . . provides fast motor starting and full-rated power for standby emergency applications. Known as Series KB, the 50-kw plant features prices reduced below those of previous models. Each is equipped with an International Harvester UV-401 V-8 gasoline engine and Onan "Magneciter" generator. The unit is rated 50 kw, 62.5 kva at 0.8 p.f. and is available in all standard voltages to 600 v.

D. W. Onan & Sons Inc, Minneapolis, Minn.



Self-Threading Nuts . . .

. . . are now available in an acorn type. The Acorn Type CST nuts have a decorative dome shape that covers the ends of studs or rods to add a pleasing appearance and protect against scratching. Sizes presently available are for ⅛ and $\frac{3}{16}$-in. diameters.

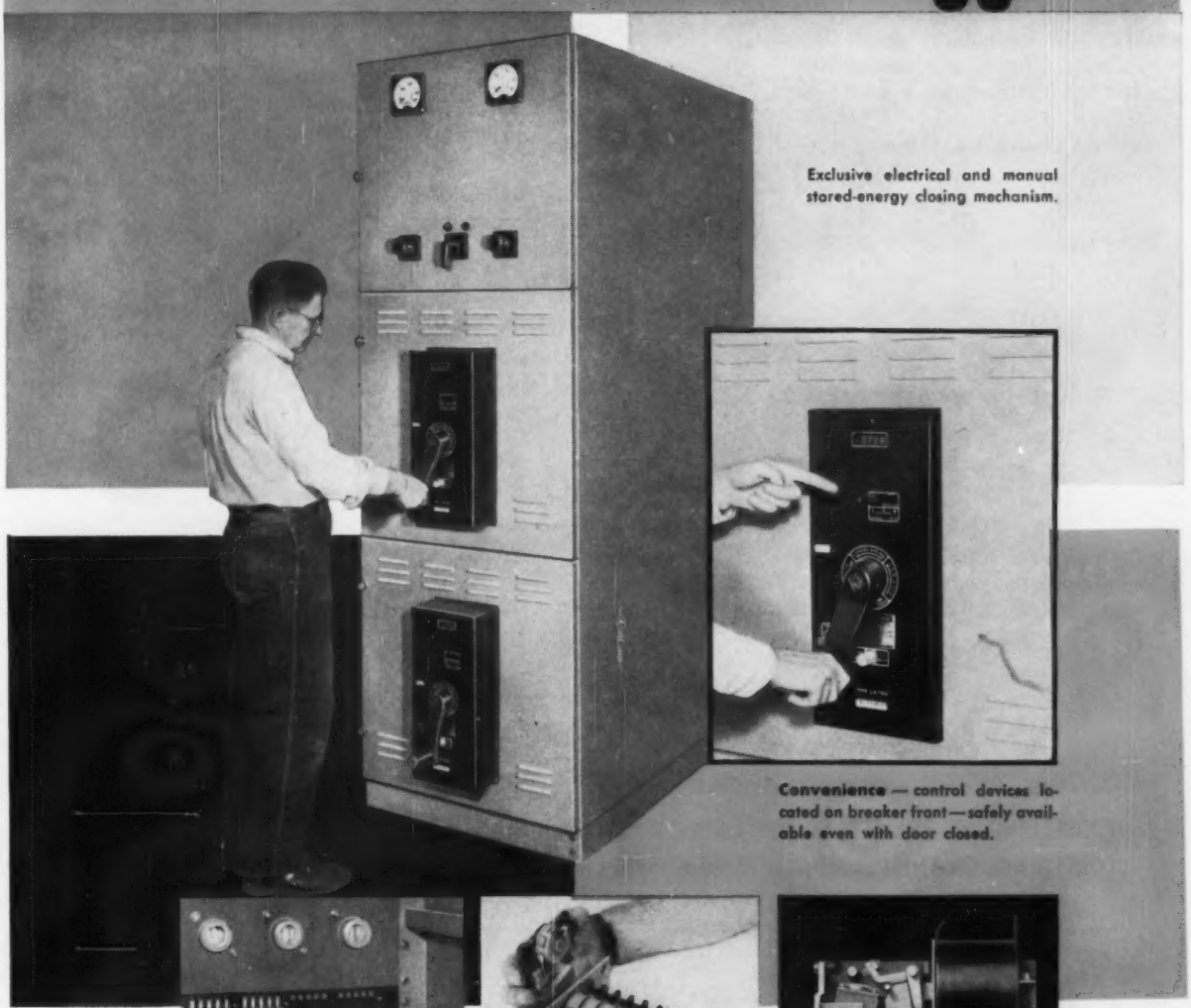
The Palnut Co, 51 Glen Rd, Mountainside, N. J.

Fault Pressure Relay . . .

. . . for power transformers incorporates pressure differential or equalizing feature to prevent false operation. Function of the relay, called Type J, is to prevent a transformer from operating while damaged. It is designed to respond only to internal transformer faults and

(*Continued on page* 110)

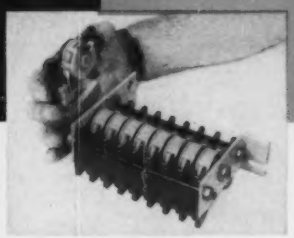
ALLIS-CHALMERS modern line for '59



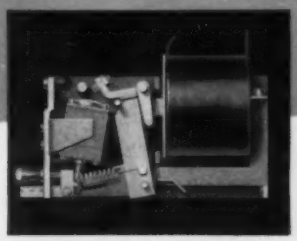
Exclusive electrical and manual stored-energy closing mechanism.

Convenience — control devices located on breaker front—safely available even with door closed.

Safety—*(a)* interlock prevents movement of closed breaker; *(b)* latch prevents rocking past disconnect position.



Flexibility—each stage of auxiliary switch assembly is individually adjustable without disassembly.



Accuracy — direct acting series-trip device is set easily, using calibration scale and adjusting knob.

Plus value in every detail

Allis-Chalmers all-new 600-volt metal-enclosed switchgear for 75,000-ampere interrupting service

Just a few of the operating . . . safety . . . and application features of A-C's new design are shown. There are many other features that will interest you, such as unitized construction, the use of polyester glass insulation, and spring-held dust seals.

Get the details! Contact your nearby A-C office or Allis-Chalmers, Power Equipment Division, Milwaukee 1, Wisconsin.

Plan to stay ahead... MODERNIZE!

A-1038-E

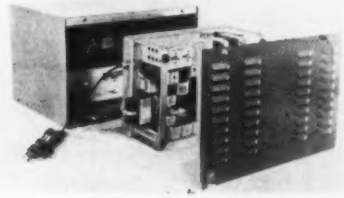
ALLIS-CHALMERS

Fault Pressure Relay . . .

(*Continued from page* 108)

not to line through-faults, system surges or mechanical shock and vibration. The relay is normally located on the transformer tank near the base.

General Electric Co, Schenectady 5, N. Y.



Mobile Radio . . .

. . . combines transistorized power supply with the combination speaker-control unit. This permits the smaller transmitter-receiver unit to be mounted anywhere in the vehicle. The Comco 580/582 Fleetcom is designed for operation in the 25-174 Mc range.

Communications Co, Inc, 300 Greco Ave, Coral Gables, Fla.

Megohmmeter . . .

. . . measures to five million megohms with laboratory accuracy. Six direct reading ranges are provided: 1-50, 10-500, 100-5,000, 10,000-500,000 and 100,000-5,000,000 megohms. Test voltage variation is less than ½% over entire range with power line fluctuations from 95 to 135 v. Weight of the Model 2570 is 14 lb.

Associated Research, Inc, 3777 W Belmont Ave, Chicago 18, Ill.

PROCEEDINGS OF THE SECOND UNITED NATIONS INTERNATIONAL CONFERENCE ON THE PEACEFUL USES OF ATOMIC ENERGY,

Geneva, September 1958 ENGLISH EDITION—33 volumes.

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Sales & Circulation
New York, N. Y.

Descriptive Brochures available on request.

Fog-Type Insulator . . .

. . . is available in an improved model. The 5-in. fog-type suspension insulator provides greater leakage distances, higher impulse and low frequency flashover, and reduced radio interference at higher voltages.

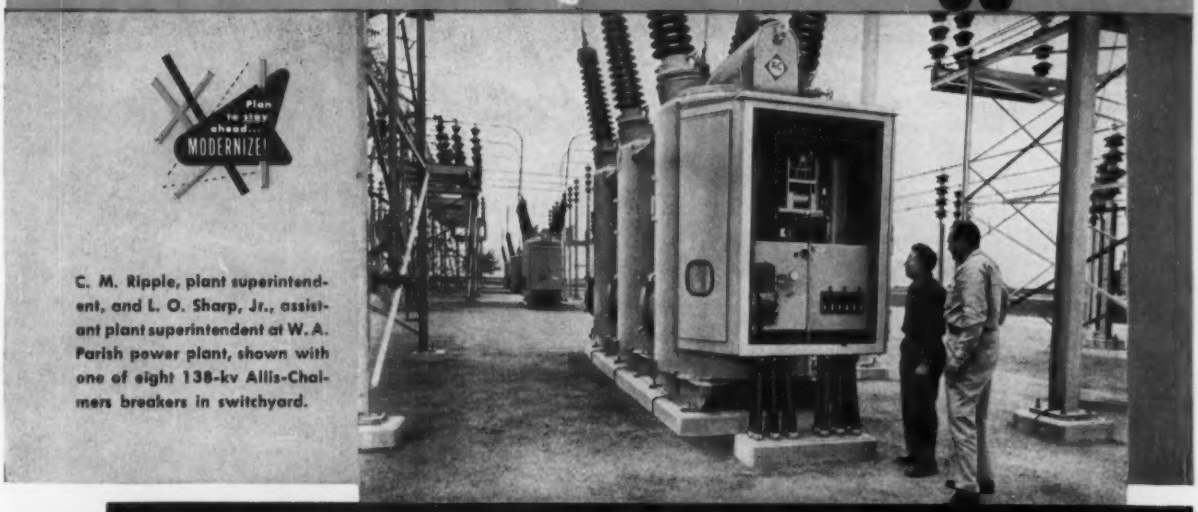
Line Material Industries, McGraw-Edison Co, Milwaukee 1, Wis.

Substation Fixture . . .

. . . with prismatic glass lens top provides maximum illumination on disconnect switches and other overhead components. The lens top unit, No. 04252, produces two peaks of maximum candlepower, one at 105

(*Continued on page* 114)

ALLIS-CHALMERS modern line for '59



C. M. Ripple, plant superintendent, and L. O. Sharp, Jr., assistant plant superintendent at W. A. Parish power plant, shown with one of eight 138-kv Allis-Chalmers breakers in switchyard.

Look at the record at Houston Lighting & Power Company

H. C. Taylor, electrical supervisor Power Department, and A-C's J. O. Higgins in Deepwater power plant switchyard.

Ten Allis-Chalmers breakers with *Pneu-Draulic* operators have been in service nearly five years. Eight additional units installed a year ago bring to eighteen the total number in use by the company.

In fact, the excellent performance of Allis-Chalmers breakers with *Pneu-Draulic* operators has led to their use on over 100 power systems. Repeat orders have been received from more than 60.

Behind this story is design leadership in power circuit breakers. A-C has led the way to fully mechanically trip-free operation and high speed arc interruption, as well as simplified operator design as represented by the *Pneu-Draulic* operator.

Get details from your nearby A-C office, or Allis-Chalmers, Power Equipment Division, Milwaukee 1, Wisconsin

Pneu-Draulic is an Allis-Chalmers trademark.

A-1035-E

ALLIS-CHALMERS

Readers Service

For additional information on new products, supplies, and services in this issue, the Manufacturers Editor of Electrical World offers his facilities. Check items in which you are interested in list below:

NEW EQUIPMENT

L-M ..... Arresters ☐
Ilg ..... Fans ☐
Adams ..... Transmission ☐
Onan ..... Generator ☐
Palnut ..... Nuts ☐
GE ..... Relay ☐
Communications Co ..... Radio ☐
Associated Research Megohmmeter ☐
L-M ..... Insulator ☐
Holophane ..... Fixture ☐
General Printed String ..... Tape ☐

OTHER

_____

Manufacturers Editor
Electrical World
330 W. 42nd St.
New York 36, N.Y.

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DEPT. _____
COMPANY _____
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FOR:

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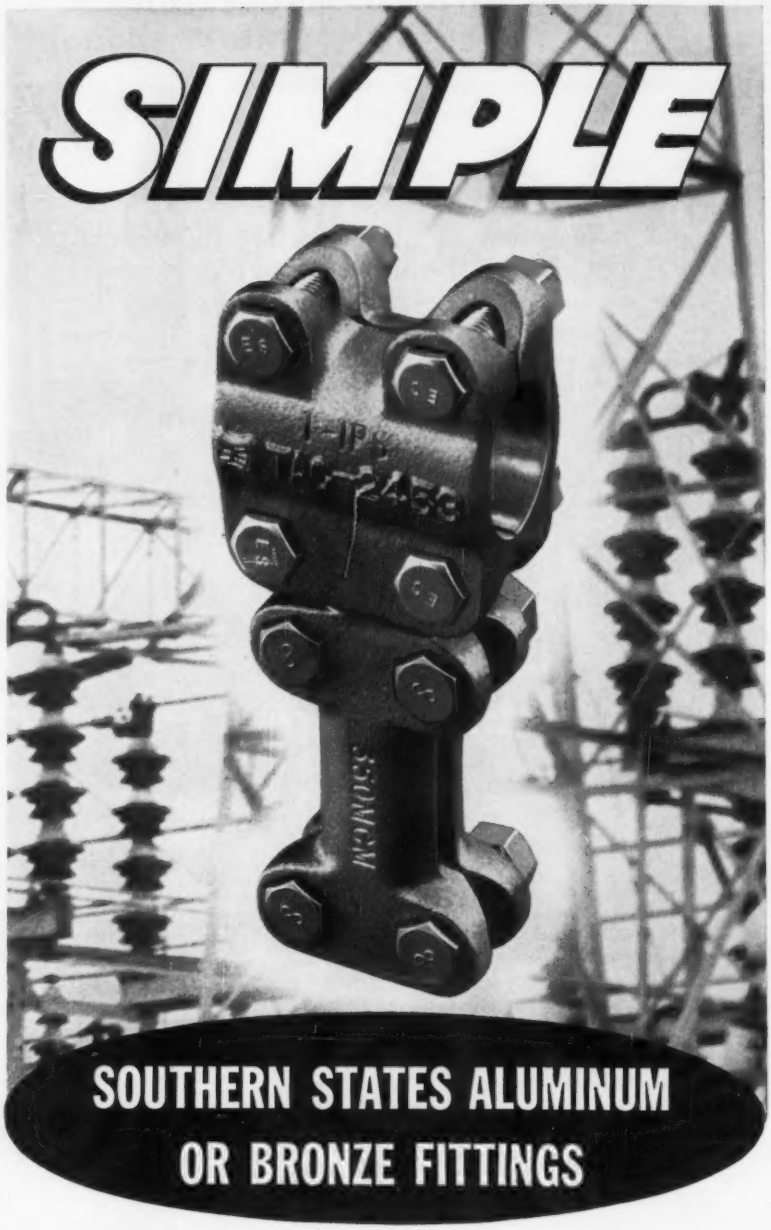
Specs ..... ☐
Trial ..... ☐
Purchase ..... ☐

JUNE 22, 1959

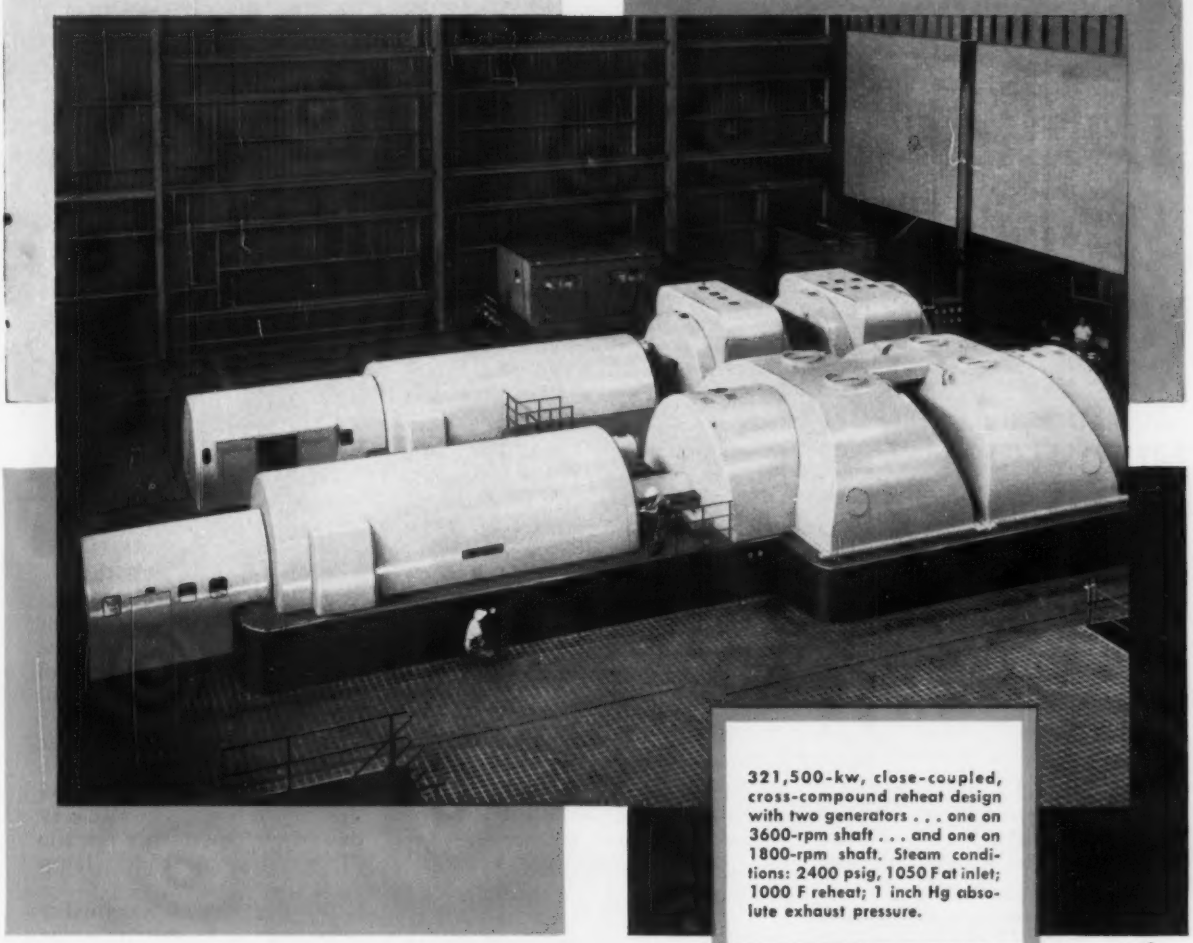


The clean, simple lines of Southern States connectors didn't just happen. The recessed hexagonal bolt heads, or proven alloys, didn't either. Nor did the resultant over-all strength, ruggedness, and durability of these high-quality fittings. All of those characteristics, which you look for in connectors, are the result of careful engineering, backed by more than 25 years experience in producing these products — from drawing board, to foundry, to you.

SS SOUTHERN STATES
EQUIPMENT CORP.
HAMPTON, GEORGIA

IN CANADA: Dominion Cutout Co., Ltd., Toronto

ALLIS-CHALMERS modern line for '59



321,500-kw, close-coupled, cross-compound reheat design with two generators . . . one on 3600-rpm shaft . . . and one on 1800-rpm shaft. Steam conditions: 2400 psig, 1050 F at inlet; 1000 F reheat; 1 inch Hg absolute exhaust pressure.

Detroit Edison's new 321,500-kw machine goes on the line

River Rouge Unit 3 increases the capacity of the Detroit Edison system to 3¼ million kilowatts — double its capacity of 10 years ago.

In size, in design, this steam turbine-generator unit was the beginning of a new era in power generation.

Of special interest are the record size 46-inch exhaust blades; and the close-coupled arrangement with the crossunder piping located above the foundation which made it possible to build to compact over-all dimensions.

For an interesting discussion of this turbine, see ASME paper 58-SA-22 . . . available through your nearby A-C office or Allis-Chalmers, Power Equipment Division, Milwaukee 1, Wisconsin.

Plan to stay ahead . . . MODERNIZE!

ALLIS-CHALMERS

A-5938-E

Crapo

GALVANIZED STEEL STRAND FOR GUY, MESSENGER and OVERHEAD GROUND WIRE

The high, uniform, consistently-dependable quality of Crapo Galvanized Steel Strand is the direct result of close laboratory control over each step in manufacture. All wires used in forming a particular size and grade are produced from steel of selected analysis, carefully processed under technical supervision and stranded on precision machines. Both wire and finished strand are subjected to prescribed laboratory tests to insure the desired end result.

Heavy, uniform, tightly-bonded zinc coatings, applied by the famous Crapo Galvanizing Process, provide maximum resistance to corrosion.

Write for booklet OG-25 containing "Sag and Tension Data for Overhead Ground Wire."

INDIANA

STEEL & WIRE CO., INC., Muncie, Indiana

Substation Fixture . . .

(*Continued from page* 110)

deg and another at 180 deg. Use of the fixture guarantees high footcandle, glare-free shadowless illumination on all overhead substation equipment 25 to 100 ft above ground.

Holophane Co, Inc, 342 Madison Ave, New York 17, N. Y.

Coil Banding Tape . . .

. . . **has unusually high tensile strength** with minimum stretch. Known as Tensul-Tape, it is especially suited for liquid-filled transformers as well as repairing and rewinding heavy duty coils and armatures. It is made from unbleached, carded, warp twist cotton yarn.

General Printed String Co, 2511 S 4th St, Milwaukee 7 Wis.

More New Products

Safety **steam cleaning liquid,** F.O.-287, does heavy duty cleaning and degreasing of painted and unpainted ferrous and non-ferrous surfaces. No goggles or gloves are necessary.—Fine Organics, Inc, 205 Main St, Lodi, N. J.

Transistorized **vibration indicator** is easy to use on turbines, motors, fans, pumps and other rotating equipment. The meter weighs only 3 lb.—Vibration Engineering Service, 411 Fifteenth St, Virginia Beach, Va.

Oiler automatically maintains the oil in a bearing at a constant level. The Style CS unit incorporates a sight in the base of the oiler, permitting the operator to observe the level. —Oil-Rite Corp, 2318 Waldo Blvd, Manitowoc, Wis.

Salve for poison ivy, poison oak and sumac irritation forms protective coating over irritated area. Bullard's Formula, Cat. No. R-29, is packed in 1-oz plastic bottles, three to a unit pack.—E. D. Bullard Co, Sausalito, Cal.

"AWRIGHT, WHO GOOFED?"

When that new substation is delayed for lack of switchgear or connectors, somebody's on the spot. Whenever delivery is an important factor, be sure . . . call Royal *first!*

Royal's compact operation is purposely kept flexible so each order gets custom service and *delivery when needed.* Every one of our customers get the "Royal treatment" . . . it's a pledge we live by.

Whether your job is normal or rush, large or small, you'll like dealing with Royal—for switchgear, any of 5,000 standard connectors, or specially engineered designs. Save time and trouble—order from Royal.

For handy, on-the-spot information of Royal products, write for Bulletins on Type RVL Air Break Switch, Standardized Substations or Aluminum Power Connectors.

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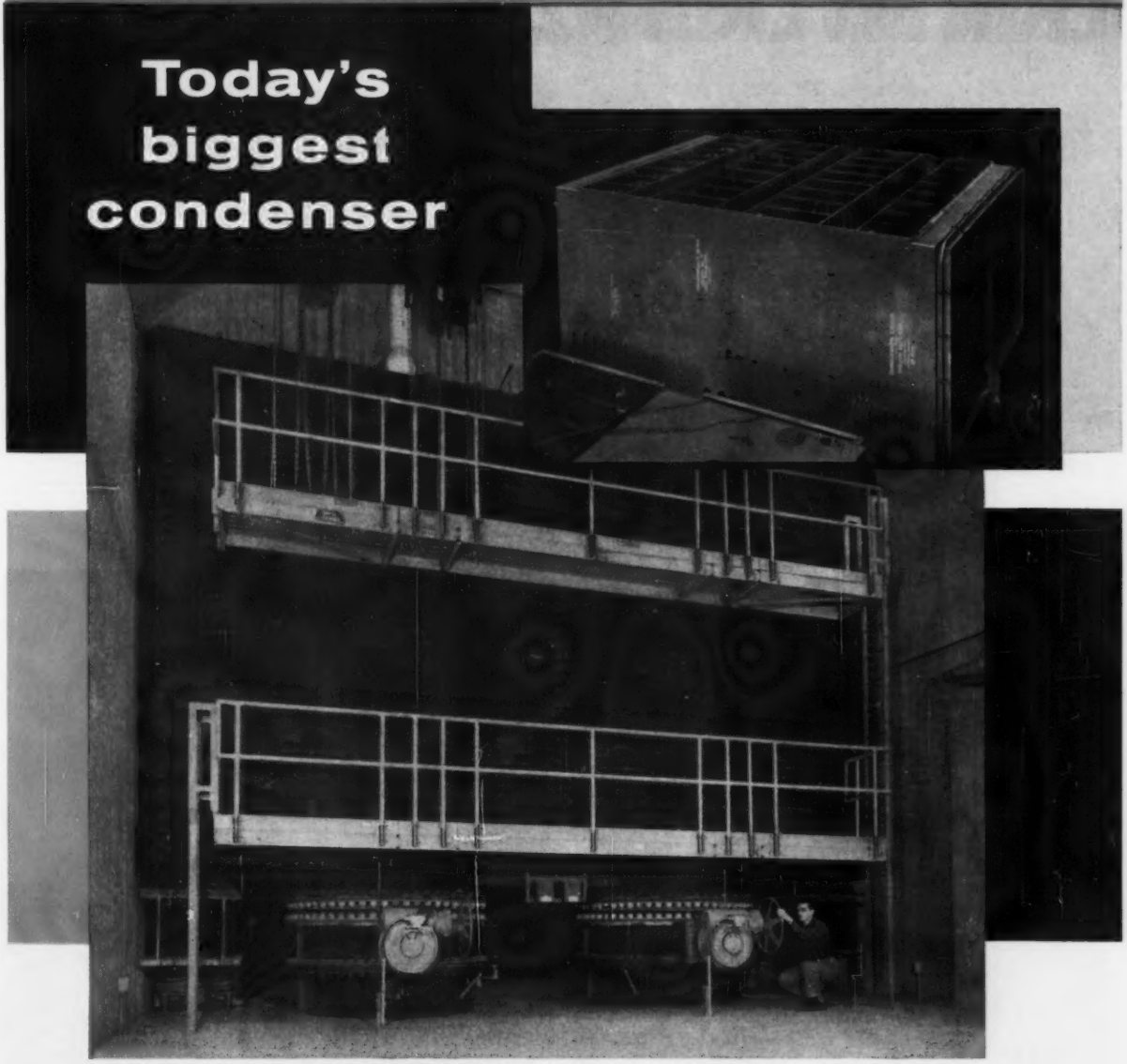
ROYAL ELECTRIC MANUFACTURING CO., INC.
1122 EAST 87TH STREET • CHICAGO 19, ILLINOIS

Designers and Manufacturers of
Power Switching Equipment and Special Electrical Devices

ALLIS-CHALMERS modern line for '59

Today's biggest condenser



200,000-square-foot condenser now in operation at Fisk Station of Commonwealth Edison

Some man-sized problems were presented by this unit... not the least of which were shipping and erection. Special Allis-Chalmers well-center cars permitted shipment of the entire shell in only four sections. Special alignment techniques developed by A-C cut installation time.

Today it serves a 327-mw Allis-Chalmers steam turbine generator. Note the compact, space saving rectangular shape pioneered by Allis-Chalmers and made practical by the A-C guided-flow condenser design.

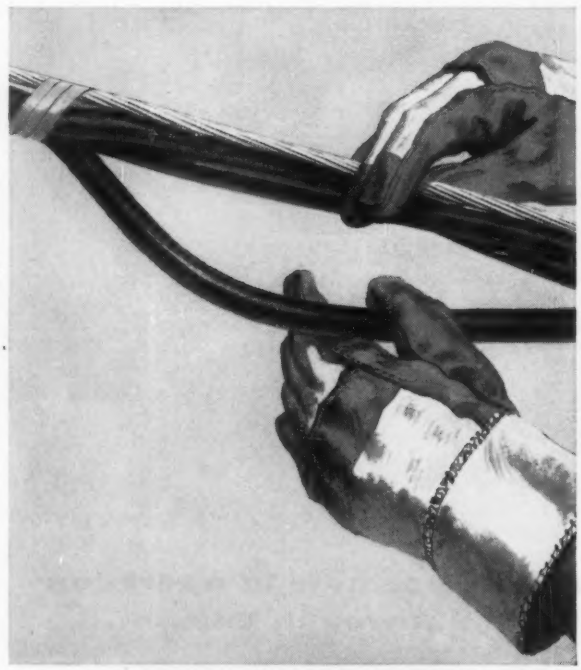
For help on your condenser problems, large or small, contact your nearby A-C office or Allis-Chalmers, Power Equipment Division, Milwaukee 1, Wisconsin.

A-C **ALLIS-CHALMERS**

A-1046-E

LIGHTWEIGHT K.W ALUMINUM INITIALLY, CUTS

Costs 20% less than copper with equal current carrying capacity!



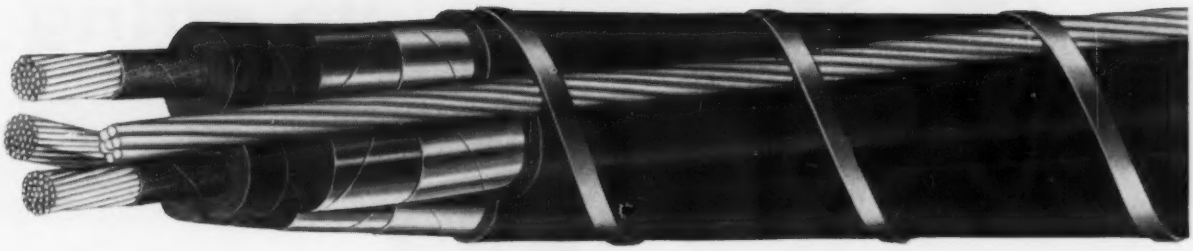
SIMPLE CONNECTIONS

Reverse lay provides simple and fast connections because the conductors can be easily separated to make taps and connections. Tapping can be accomplished quickly, safely and easily.

REDUCES TREE TRIMMING

Unlike open wire construction, compact preassembled KW aerial cable cuts tree trimming to a minimum, initially and periodically. Result: fewer service interruptions or outages during storms, less maintenance.

AERIAL CABLE COSTS LESS INSTALLATION COSTS



FASTER INSTALLATION

Due to its light weight, aluminum aerial cable can be installed to the same sags as copper cable, provides as much clearance, and reduces the tension at pole supports. Additionally, this reduced weight in some cases permits reduction of the messenger size. Less congestion on poles; decreased pole height when used for joint construction with telephone company; improved voltage regulation due to reduced reactive drop.

SAVE on first costs, save on labor and maintenance expenses now with KW aluminum aerial cable. KW preassembled aerial cable is available in both reverse lay and unilay in either aluminum or copper. For immediate service or more detailed information, call the Kaiser Aluminum sales office or KW distributor listed in your telephone directory.

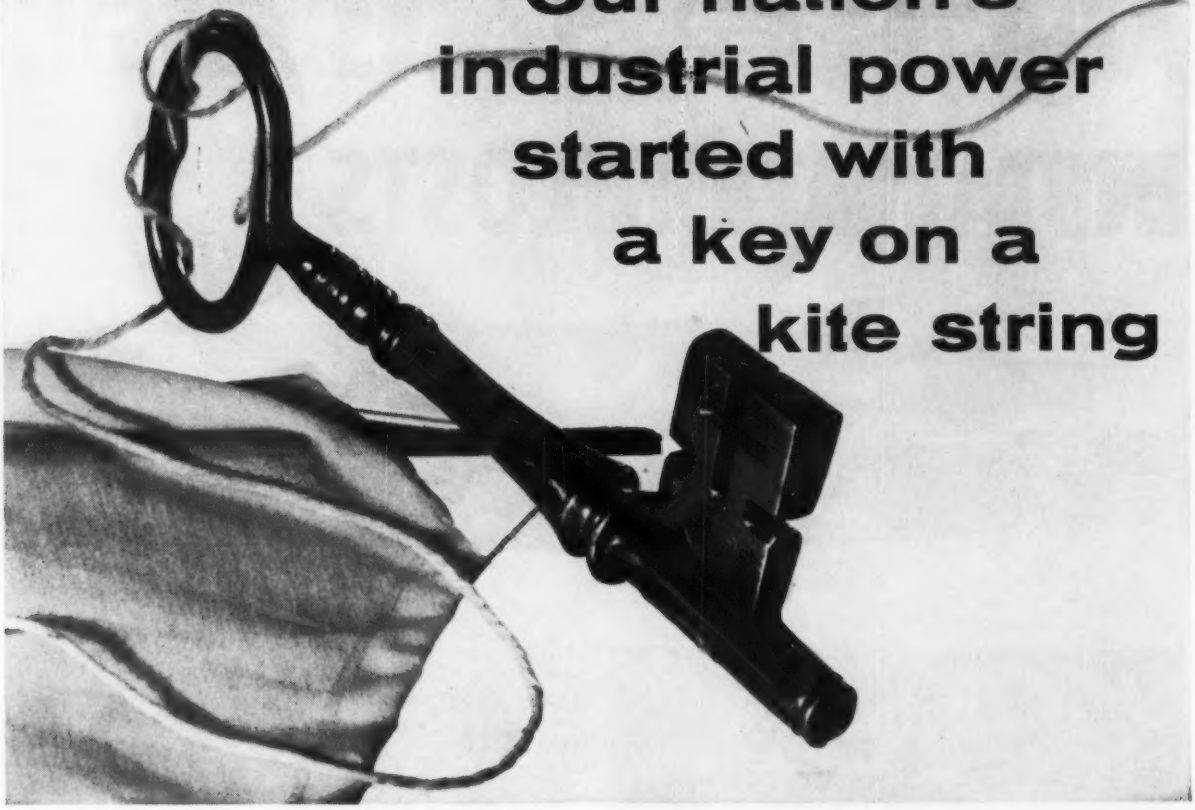
Kaiser Aluminum & Chemical Sales, Inc., 1924 Broadway, Oakland 12, California.

KAISER ALUMINUM

"IF IT CARRIES CURRENT, KW CARRIES IT!"

See "MAVERICK" • Sunday Evenings, ABC-TV Network • Consult your local TV listing.

Our nation's industrial power started with a key on a kite string

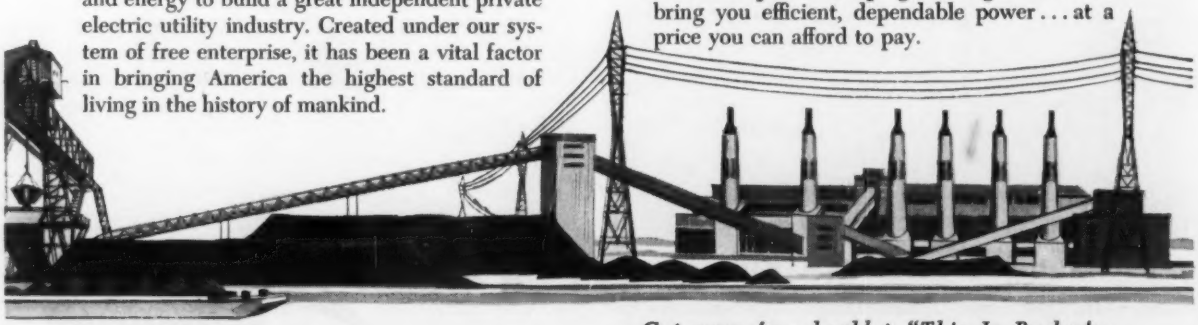


A key on a kite string and a bolt of lightning marked the first step toward the wonders of the Electric Age. Here was power . . . *unlimited power* to drive the machines that produce the necessities and luxuries of modern life at a cost within the reach of all.

This power was unharnessed until a breed of forward-thinking men risked their money, time and energy to build a great independent private electric utility industry. Created under our system of free enterprise, it has been a vital factor in bringing America the highest standard of living in the history of mankind.

The citizens of this country have every reason to appreciate and support this great basic industry.

Coal generates more electricity than all other fuels and water power combined. Peabody Coal Company supplies coal to many of the nation's leading electric utilities. Peabody is pleased to have this part in helping these great utilities bring you efficient, dependable power . . . at a price you can afford to pay.



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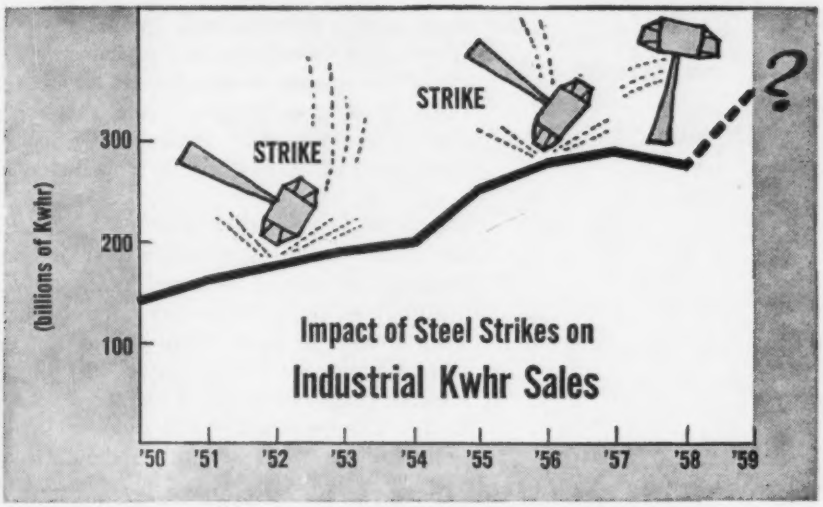
Report on
Electrical
Business Outlook



How Steel Strike Will Hit Utilities

If the steelworkers go out after their contract expires June 30, it's sure to throw a hitch into the progress of the recovery. How serious a hitch is very much open to question, but it looks unlikely that a steel strike this year will have much harmful impact on the economy in general or the electric utility industry in particular. To see why, it would be a good idea to look back at the last two steel strikes and to consider the similarities—and differences—between those years and this one.

A strike in the steel industry can affect the economy in three ways: First, there is the direct effect of shutdown in one of our largest concentrated industries. This is a sure thing if a strike is called, and it is felt immediately by utilities that serve steel centers. Second, there is an effect on industries that count the steel makers among their important customers—chemicals manufacturing is a good example. Third, and most important, a shortage of steel can cause layoffs and shutdowns in a host of industries that depend on steel supplies. If the strike is long enough, its effect could thus spread to many areas where utilities do not depend on the steel industry for load.

If there's a strike, load will certainly be down in the steelmaking centers, but it looks as though inventories are now high enough to withstand a fairly long shutdown of the steel mills before widespread shutdowns can be expected in the steel-using industries. In 1956 the steel workers were out for 34 days. In 1952 they were out 55 days. But in neither year did the strike touch off a broad industrial decline. The economy showed a surprising amount of resiliency in its recovery from both of these strikes.

In 1952, the strike hit an economy that was not so well prepared as it is today. With the Korean War on, steel mills had been humming at close to 100% of capacity for more than two years, and steel was still in short enough supply to be kept under tight control by the Defense Production Administration. Stocks had been built up to what the DPA called "a satisfactory level" before the strike, but by the middle of July (after six weeks of strike) an estimated 50% to 60% of these inventories had been chewed up and many steel-using industries were beginning to feel the repercussions. The DPA summed it up: "The loss of steel

from the worst production stoppage in American history changed a situation of increasing supply of materials to a situation of shortage worse than has been faced since the defense program began."

Some utilities were hit hard. In June of 1952, for example, Cleveland Electric Illuminating Co reported that its industrial sales were off about 10%, and laid the decline to reduced operations in the steel mills and fabricating plants. During the early weeks of the same strike, Detroit Edison Co noted that primary light and power sales were running 20% below estimates. And in Pittsburgh, Duquesne Light Co suffered a 25% decline in total kwhr sales.

But the U. S. as a whole was not so seriously affected. U. S. industrial kwhr sales seem to correlate closely with industrial production, and the Federal Reserve Board assigns the steel industry a weight of only 3% in computing its industrial production index. In spite of its long duration, the 1952 steel strike did not reach the point where its effect on the rest of the economy showed up significantly in the FRB index or in U. S. kwhr sales. At its lowest point, the seasonally adjusted index of industrial production was off about 4% from its level before the shutdown. Without seasonal adjustment (for normally scheduled vacations, etc.), the dip was about 10%.

Industrial kwhr sales followed the industrial production index, with a decline of almost 10%—about half of which could be attributed to seasonal factors. From 13.83 billion kwhr in May, industrial sales fell to 13.20 billion kwhr in June, and to 12.64 billion kwhr in July. By August, however, industrial sales had reached 14.10 billion kwhr. The rest of the year saw further improvement.

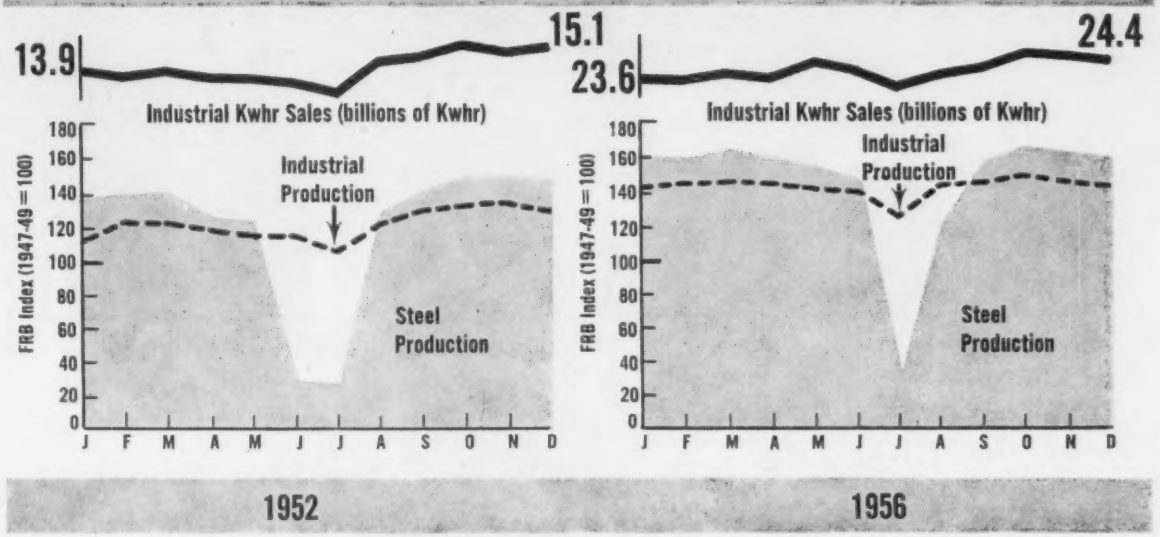
The economy snapped back even quicker from the 34-day steel strike in 1956. Steel users were better prepared for that one, with 25 million tons of steel in their stockpiles. During the strike itself, which encompassed the month of July, industrial production dropped about 3½% as measured by the seasonally adjusted FRB index. Industrial kwhr sales went off about 5% for the month of July. With the settlement in August, however, both total industrial production and kwhr sales resumed their pre-strike trends almost immediately.

There are some differences this time, but they don't point to a situation bad enough to stop the recovery. Steel inventories are not quite up to the 1956 pre-strike level, but nothing like the 1952 shortage faces U. S. industry. Inventories have been building up steadily ever since last September. From 13 million tons in January, they are due to hit 21 million tons by the end of this month. At the present rate of consumption, this would appear to be enough to last for three months. In practice, however, everything doesn't work out that smoothly. Not only must the amount of steel be sufficient, it must also be of the right types and distributed in the right places. Thus in 1952 the U. S. economy began to feel the pinch when inventories still stood at about 50% of the pre-strike level.

Today the consensus is that only a very long strike can do serious damage to the economy. *Steel* magazine said that a few steel users would be hurt after a month; after six weeks, unbalanced inventories would have many customers in trouble; after eight weeks, steel shortages would force mass shutdowns. If a strike this year reaches that stage, its effects would throw a monkey wrench into overall industrial production and kwhr sales, but the evidence shows that the only utilities likely to be harmed by a short strike are those which depend on the steel industry itself for a sizable portion of their load.

A long strike does not seem likely this year. Nobody wants one. The steelworkers still have the memory of last year's recession fresh in their minds —and pocketbooks. The government has had anxious eyes fixed on the steel industry since early this year. And the steel companies themselves, while

Here's What Happened During the Last Two Steel Strikes



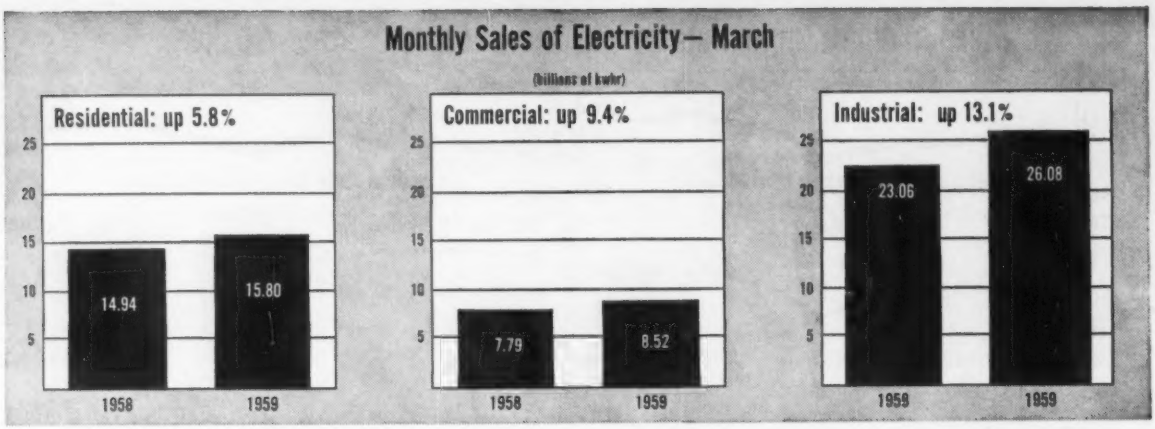
they might take a short strike with some degree of equanimity, are justifiably worried about the consequences of a long one.

The rate of inventory buildup has been so great that the steel companies face a slow third quarter whether or not there's a strike. If no walkout occurs, the best steelmakers could hope for would be that the cut in steel users' inventories would be small. Since steel stocks rose by at least 5 million tons in the second quarter, even a cut of 1 million tons would result in a net change of around 6 million tons, and this would be sure to pull third quarter operating rates down from the nineties. Best guess is for a third quarter "no-strike" operating rate of about 70%.

The steel supply picture has picked up another facet since 1952 and 1956. The settlements of the previous two strikes have helped make imports a cause of greater concern to the steel companies. Although U. S. industry could not supply itself for long with European or Japanese steel, the fact remains that overseas steel suppliers have received more attention this year than ever before. During the first quarter of 1959, this country's steel imports exceeded exports for the first time on record.

The steel companies also remember bitterly their experience in 1952, when the government for a time took over the industry—and they are not likely to flirt with government intervention in any form. Washington observers agree that the government has no intention of letting a steel strike last long enough to pull the rug out from under the economy.

Most utilities have more to fear from the settlement than the strike itself. Even a seven-cent hourly wage hike—equivalent to the increase gained by the automobile workers—would jack up steelmaking costs by something like $4 a ton. And the United Steelworkers, although their demands were not clear when EW went to press, seem sure to aim for several times that amount. Not many observers have yet hazarded a guess as to the outcome of the strike which has not yet begun, but United Business Service recently predicted a wage hike "followed by price advances of up to $4 a ton." If the past is a guide, this increase would touch off broad increases in the prices of electrical equipment. By a rough rule of thumb, an increase of $4 a ton would add about 80¢ a kw to utility construction costs—increasing the power industry's expenses by some $8- to $9 million for the year 1960 alone.



Power Statistics

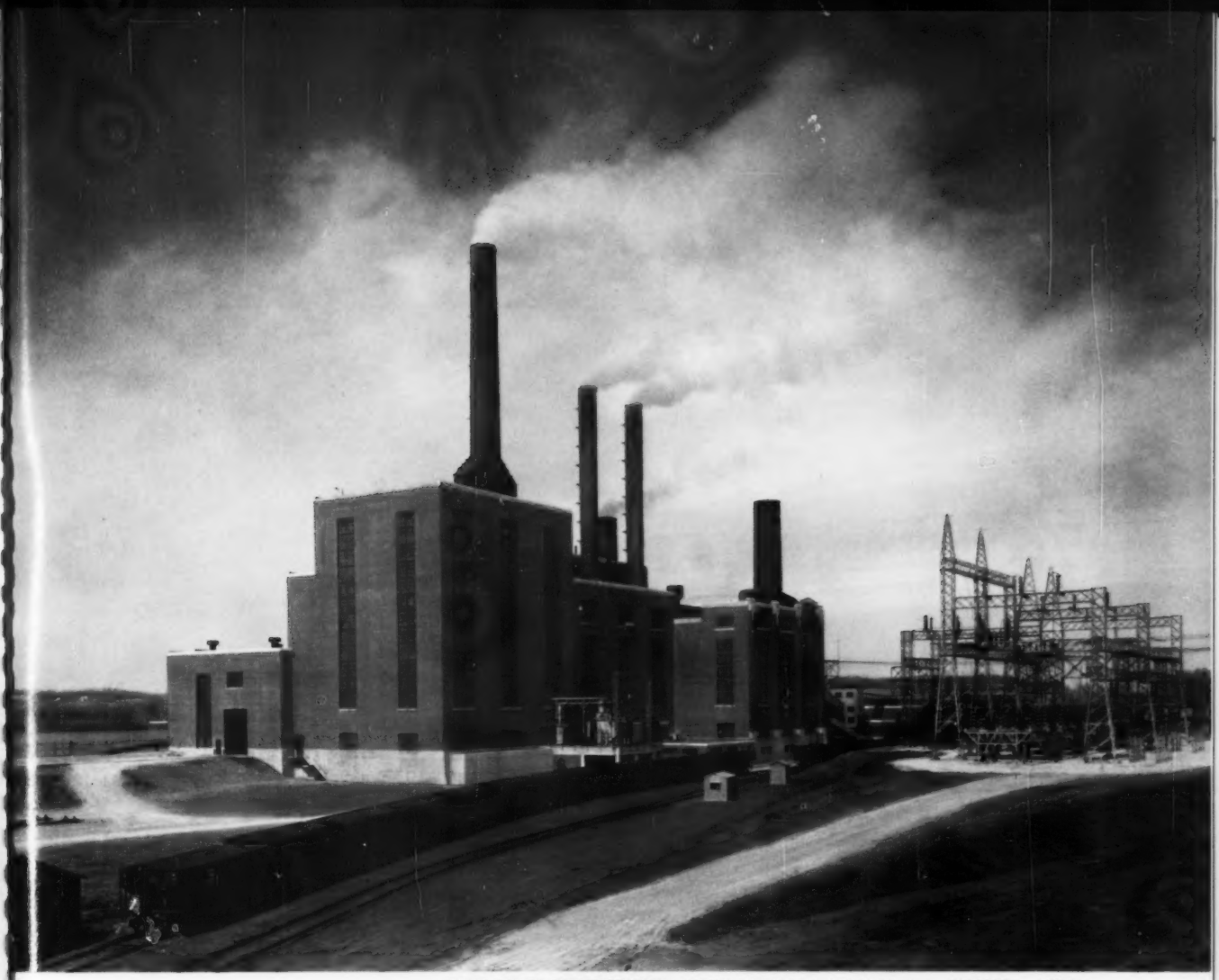
		Latest Month	Year Ago	Annual Change %
Capacity	Mar.	145.63	130.36	11.7
Peak—Class I Systems... million kw	Dec.	107.1	102.4	4.6
Estimated Dec. '59 Peak	Mar.	124.8	128.5	— 2.9
Production—billion kwhr	Mar.	58.35	52.62	10.9
Hydro		12.02	12.71	— 5.4
Fuel		46.33	39.92	16.1
Sales—billion kwhr	Mar.	53.16	48.30	10.1
Industrial		26.08	23.06	13.1
Fuel Consumption	Mar.			
Coal—million tons		14.60	13.38	9.1
Oil—million barrels		8.58	5.95	44.2
Gas—billion cu ft		101.00	87.89	14.9
Net Income Class A & B Co's—$ million	Mar.	148.52	139.33	6.6

Note: *Beginning in January 1959, a reclassification of customers eliminated the "rural" classification. Data previously classified as "rural" is now allocated principally between the "residential" and "commercial" classes. This means that 1959 data on residential sales, commercial sales, other sales, and residential customers are not comparable to 1958 data.*

Business Statistics

Indexes: 1947–49 = 100				
FRB Industrial Production	May.	152	127	19.7
ENR Construction Cost	June	166.7	158.8	5.0
BLS Cost-of-living	Apr.	123.9	123.5	0.3
New Orders for Machinery (1950 = 100)	Apr.	193	137	40.9
NEMA Sales				
Insulation materials	Mar.	152	108	40.7
Electric appliances		117	86	36.0
Wholesale prices				
Motors and generators	Mar.	146.4	143.8	1.8
Transformers and regulators		148.8	147.6	0.8
Switchgear and fuses		173.6	172.7	0.5
GNP—annual rate—$ billion	1st qtr.	467.0	425.0	9.9

Significant changes: Strong pickup in appliance sales continued in March, as NEMA's index jumped to highest level in three years. Sales of insulation materials rose to a two-year high.



GRAND TOWER POWER STATION CENTRAL ILLINOIS PUBLIC SERVICE COMPANY *210,000 kw—4 Units*

Power in Illinois. . .

The center of United States population has been moving steadily westward and has recently reached a point near Olney, Illinois, a community served by Central Illinois Public Service Company. The trend of industry to follow population movements is illustrated by the rapid increase in industrial activity in newly developed areas. Foreseeing this trend, Central Illinois Public Service Company has engaged in an expansion program which added 100,000 kw capacity in 1958 and will add another 200,000 kw by 1960. Continually experiencing higher and higher load requirements from large power consumers, the company's recent expansion program has truly been tuned to the future.

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"No man can improve an original invention..."

—William Blake

THERE are many scientists today who would argue this point with Blake.

At Bell Telephone Laboratories, for example, we have seen original inventions improved and re-improved countless times, the better to serve mankind.

But William Blake went on to say "... nor can an original invention exist without execution organized, delineated and articulated." Here Blake expressed ideas that apply with striking emphasis today. At Bell Laboratories organized effort is constantly aimed at fostering an environment in which inventions can exist and prosper, where they can be expressed either as ideas or in physical form, and where clear understanding of their principles can be achieved.

By helping scientists and engineers to reach for the things they seek, by organizing and coordinating their efforts, Bell Laboratories has made important contributions to the art of communications: proof of the wave nature of the electron, first research in radio astronomy, discovery of the transistor principle, invention of the feedback amplifier. Such ventures into the unknown have twice brought the Nobel Prize to Bell Laboratories scientists, and at the same time have helped create the most efficient and versatile telephone system ever known.

William Blake (1757-1827), a versatile genius, was famous for brilliant, sometimes prophetic, insights which he expressed with provocative beauty in drawing, painting, poetry and prose.

BELL TELEPHONE LABORATORIES

WORLD CENTER OF COMMUNICATIONS RESEARCH AND DEVELOPMENT

Utilities Told to Stress Salesmanship

"Don't sell an appliance, sell comfort, convenience, contentment; don't sell things, sell ideas," Edwin V. Hellyar, Monsanto Chemical Corp, said in one of the highlight speeches at the recent Electric Council of New England Workshop in Portsmouth, N. H.

"Selling is the most undernourished profession we know. Too often it is just product training and sales technique is forgotten," he said. But if a salesman creates the desire to buy from him much of the selling job is done. This is because "we buy from the people we like best," Hellyar commented.

Defining what a salesman is, he said personality is important but if the man is anything but a hermit, with proper instruction and guidance, he'll make good.

Goods can be made on a machine but it takes a person to sell them, Hellyar noted. He exampled this by quoting Andrew Carnegie, "Take my factory and leave my people and we will build better plants. Take my people and leave my factories and grass will grow around my door."

The impact of the new lighting levels on utilities was discussed by Richard E. Slauer, Fixture Division, Sylvania Electric Products, Inc, Wheeling, W. Va. "Light has lost none of its basic value to utility programs," he said. "Don't say 'we're not interested, lighting isn't worth it.'" Lighting costs a company less than a 20-minute coffee break, he pointed out.

'Don't Sell Lighting Short'

Don't sell lighting short, he cautioned. The fact that gas lighting managed to make headlines last year is only another illustration of how versatile lighting is.

He also noted that too many people are taking lighting complacently. Twenty thousand dollar homes with $3,000 kitchens have one $5.98 lighting fixture.

He suggested: Get an actual installation in the service area that will sell lighting.

Slauer also noted that the industrial plant is a good market. "A production plant doesn't have a reject unless someone didn't see right," he said.

Stressing the modernization market, he pointed out that light can be one of the biggest steps in remodernization. Five-sixths of all the structures existing today have an opening for improved lighting, he said.

Space heating sales for schools, motels and apartments are good and appear destined to be even better, according to R. L. Boyd, Edwin L. Wiegand Co. Electric heating is the only salvation for continued load growth in the years ahead, he said.

Sell yourself on the potential, talk about it, reap the benefits, he urged. Based on the cost of the BTU, electric heating cost is impractical, he said, but experience paints a different picture. A 1¾¢ rate for electric heating is competing very favorably throughout the country, he said.

The first school was electrically heated in 1955, today there are 200, Boyd pointed out. In motels, traveller preference becomes apparent after one or two motels in an area have electric heating. Other owners are easier to sell then, too, he said.

Advantages of electric heating, in apartment buildings, according to Boyd, are: Tenant can regulate in each room; lower installation cost; there is space for an extra apartment; cost of redecorating is cut in half; and net cost doesn't vary.

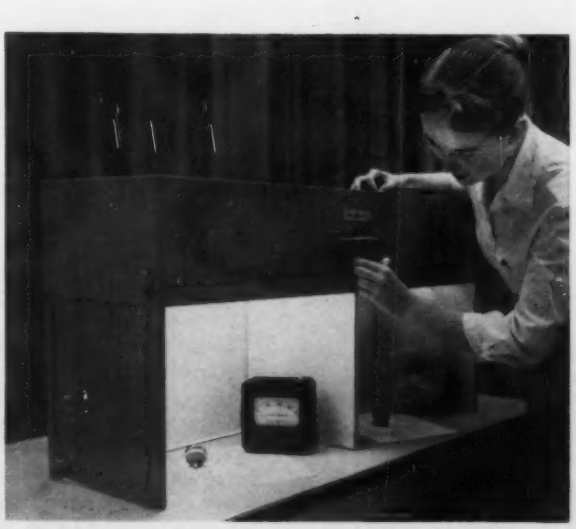
General Electric Develops Comparative Lighting Kit

A portable "See-Level Comparator Kit" has been developed by the General Electric Co's Large Lamp Dept to show prospective lighting customers that they need more lighting.

The kit has two lighted compartments, 13x19x12 in. The prospect places a sample of his work in each compartment. The lighting in one compartment is set to the present lighting level in his establishment (right, in photo); in the other he changes the lighting level to what he considers the best seeing level.

At a recent plant maintenance and engineering show more than 90 prospective customers selected an average of 950 footcandles for a typical industrial task, GE reports.

The kit contains a power cord, cool white fluorescent lamps and ballasts, 30-w reflector bulbs, dark and light felt visual backgrounds and a multiplier clip to fit a pocket light meter. Cost of the unit is $100.00 plus shipping costs, available through GE district offices.



News About People

DUNHAM

HAMILTON

WILSON

Central Maine Names Three New VPs

Central Maine Power Co has named three new vice presidents: William H. Dunham, executive vice president; Harry E. Hamilton, vice president and treasurer, and Nathaniel W. Wilson.

Dunham joined Central Maine in 1939 when it was a subsidiary of New England Public Service Co. He was appointed executive assistant to the president in 1952 and became a vice president in 1954.

Hamilton entered the company in 1926 when it was an affiliate of New England Public Service. Since 1953 he has been treasurer of Central Maine.

Wilson joined New England Public Service Co in 1926 as an attorney, became secretary and general counsel of CMP in 1958.

Shultz, Kraakevik Elected VPs at Illinois Power

SHULTZ

E. A. Shultz and Archie Kraakevik have been elected vice presidents of Illinois Power Co. D. F. Meek has been named secretary.

Shultz went with Illinois Power in 1937 on the engineering staff. In 1946 he became chief system supervisor and later manager of electrical operations.

Kraakevik began his career with Illinois Power Co in 1926 with the company's real estate and tax department in Chicago. In 1936 he transferred to the Champaign, Ill., office as assistant purchasing agent. He became purchasing agent in 1946. In 1958, he was named manager of services and supplies.

KRAAKEVIK

Yates Made Georgia Power Vice President

Eugene A. Yates, Jr., manager of the industrial development division of Georgia Power Co, has been elected a vice president of the company. He has been in charge of the company's industrial development activities since September, 1955.

Yates joined Georgia Power in 1947 as results engineer at Plant Atkinson. After service in Korea in 1951 and 1952, he rejoined the company as a field supervisor for new industry in the area development division.

(*More News About People on p* 128)

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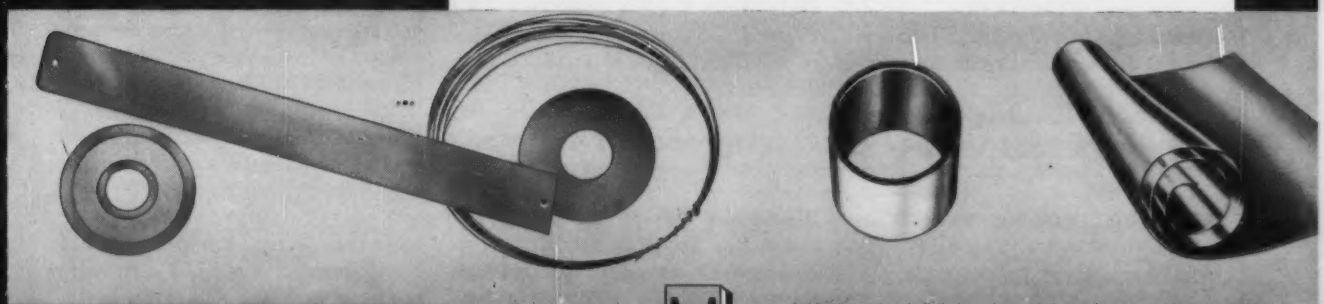

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Knight Heads Western Precipitation

Alfred W. Knight has been elected president of Western Precipitation Corp, succeeding Walter A. Schmidt, who remains as chairman of the board.

Knight joined the company in 1924. He was elected vice president in 1938, and executive vice president and general manager in 1956.

Well known as a patent attorney, he is past president of the Patent Law Association of Los Angeles.

Schmidt, who had been president since 1911, joined the company in 1907.

Resor Elected VP at Bozell & Jacobs

Robert Resor has been elected a vice president of Bozell & Jacobs, Inc.

Resor has been national coordinator of the Electric Companies Public Information Program since May, 1955. A former vice president of Jones & Brakeley, he has been associated with two other New York public relations agencies, Stephen E. Fitzgerald & Associates, and the Earle Ferris Co.

SALES ASSIGNMENTS

Line Material Industries has named John A. Schwenke, Thomas J. White, and William A. Schultejans to new field engineer assignments. Schwenke has been assigned to the Chicago office; White to Springfield, Ill., and Schultejans to Decatur.

The Bristol Co has appointed Nicholas W. Edes, Jr., to the Cleveland district to serve northern Ohio.

Okonite Co has appointed James R. Haden district manager in the newly designated Kansas City office. Thomas M. Brinkley has been named district manager in the newly created Milwaukee district office.

Continental-Diamond Fibre Corp has promoted W. R. Gotshall to district manager at Indianapolis.

Westinghouse Electric Corp has appointed Rex N. Anderson area sales manager for the Pacific Coast region, and L. G. Weiser Louisville branch manager, apparatus sales.

Bailey Meter Co has opened a New Jersey sales office at 110 Halstead St, E. Orange, N. J., under the managership of H. C. Wheaton, who also manages the New York district office.

Ohio Brass Co has appointed Otto Price, Jr., district manager to assist in the New England territory.

S&C Electric Co has named Ted Palmer manager of the Western sales division.

Blaw-Knox Co's Copes-Vulcan Division has appointed Franklin Engineering Co as sales representative for the division's products in Arizona and certain areas of Nevada and California.

Anderson Electric Corp has appointed Andrew L. Polich, Inc., Portland, Ore., as sales and service representative in Oregon and parts of southern Washington to handle the complete lines of connectors. James J. Stenger has been appointed factory sales representative for the state of Ohio.

Fisher-Pierce Co has appointed J. W. Stafford of Almagated Engineering Services Ltd as a sales representative with headquarters at 882 E. Cordova St., Vancouver, B. C.

R T & E Corp has appointed David B. Cole sales representative in the Los Angeles area.

Southern States Equipment Corp has appointed Jay G. Gates sales representative for Ohio: Jesse W. Eakins Co, Michigan; and L. M. Rudbeck, Indiana.

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Transformer Designing Engineer, who is capable of designing oil cooled, electrical power transformers, up to 1000 KVA. Location New Jersey. New company going into business. P-1880, Electrical World.

Manager Wanted: Generating and transmission cooperative with headquarters at Montrose, Colorado. Man selected must have background of sound education backed up by responsible management level experience. Only men of top management qualifications will be considered. Salary commensurate with position. Write Colorado-Ute Electric Association, Inc., Montrose, Colorado for application blank promptly. Position to be filled at once.

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Network Helps French Meet Demands

(*Continued from page* 61)

of which were built by state-owned coal mines. These plants—fired with inferior grades of coal, often slimes and washings piped directly from the mine—produced 11,200-million kwhr in 1957 while EDF thermal plants accounted for 14,100-million kwhr

Today's steam plants are using 125-Mw sets; 250-Mw sets are planned for future installations. In the past four years steam pressures and temperatures have gone up fast. At Porcheville, one of two plants completed last year in the Paris area, pressure is 1,800 psi at 1,004F with 370 psi, 1,004F reheat. For 250-Mw units, specifications call for 2,340 psi and 1,050F.

Gas-fired thermal plants have captured the interest of French utility men since the discovery of the vast Lacq field in the industrially backward Southwest in 1953. By 1960, when a transport network is extended to Paris, the field will be producing the equivalent of 2.8-million tons of coal annually.

The first atomic power flowing into the grid came from Marcoule where the French Atomic Energy Commission has constructed a plutonium-producing plant with three natural-uranium fueled, graphite-moderated, gas-cooled reactors. The second and third reactors, designated G2 and G3, have 45-Mva generators operating at 10.5 kv, 50 cycles. Hot CO_2 gas at 220 psi from the 150-Mw (t) reactors is fed to four 104-ft-high heat exchangers to produce steam for the 40-Mw three-stage turbines.

At the EDF-1 atom plant now rising near Chinon, comparable fuel, moderation and coolant techniques will be used, but at 367 psi. One heat exchanger, with 120 elements in parallel, will feed steam to an 83-Mw, two-stage turbine. Design steam characteristics, at the turbine, are 307 psi at 650F for the high-pressure stage, 61 psi at 433F for the low-pressure stage. The turbine will drive a 102.5 Mva generator operating at 14.5 kv.

EDF-1 will be completed at the end of this year and will be followed by EDF-2 in 1961. In combination with the Marcoule plant, this will give France a total atomic-power capacity of 220 Mw. By 1965, a total of 850 Mw is expected.

Growth of the transmission system has kept pace with the rise of generating capacity. Today some 13,000 mi of lines, split about equally between 225 and 150 kv, crisscross France. Development of the hydro in the Alps and Masif Central brought with it the plan of designing and building 225 kv lines that could be converted to 380-kv single circuits.

The first conversion on a 280-mi link between the Alps and Paris took only two months and stepped up capacity from 350 to 550 Mw. No-load taps on autotransformers, in conjunction with the reactance coils used to compensate for high reactive power (about 250 Mvar) produced by the line, make it possible to operate the line at about the rated voltage under all load conditions without transfer of active power to or from the 225 kv system.

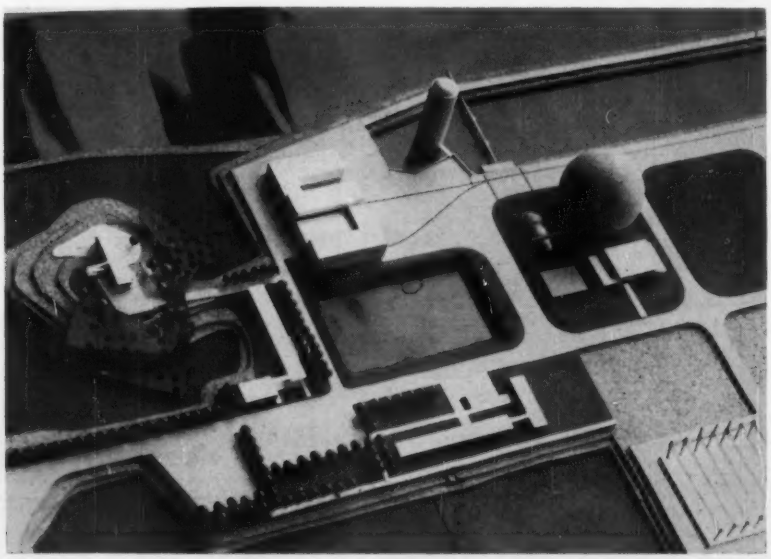
Plans Call for More 380 Kv

Long range plans call for a second 380-kv Alps-Paris line and short 380-kv lines to Switzerland, Western Germany and Belgium. In addition, a second system will be developed from the Masif Central to Paris and from Bordeaux to the Lacq region's gas-fired plants. In 1961 the cross-channel submarine tie with Britain will provide a power exchange during peaks that will save the two countries $850,000 a year.

An arduous standardization of distribution voltages and frequencies followed EDF's inception. In 1958, EDF had about 200,000 mi of subtransmission and 270,000 mi of distribution lines operating. Subtransmission is at four values between 12 and 60 kv. Low voltage is being upped to 220/380 v as fast as possible. In the French set-up, low-voltage customers get power directly from substation lines.

Some recent distribution developments include:

- Vacuum-cast or prestressed concrete poles.
- Pole-mounted substations, for rural installations, standardized at 16, 25 and 40 kva. Low side is protected by a breaker if necessary; the high side, only by arcing horns against atmospheric voltage surges.
- Automatic-reclosing breakers on subtransmission feeders coupled with pole-mounted breakers for tap lines.
- Self-supporting, multi-conductor cables for low-voltage service entrances. The cable is insulated with chloroprene and runs directly from the line to customer's switch; there are no junction boxes.



ATOMIC POWER CAPACITY will hit 220 Mw at end of 1961. This model is EDF-1, a natural-uranium fueled, graphite moderated, gas-cooled plant near Chinon in the Loire Valley. EDF-2 is about 20% finished with concrete pouring

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The Meetings Calendar

JUNE

Utility Commission Engineers—37th Annual Conference Sheraton-Palace Hotel, San Francisco, Calif., June 30-July 2.

International Electrotechnical Commission—Annual Meeting, Madrid, Spain, June 30-July 10.

JULY

Edison Electric Institute—Accident Prevention Committee, Biltmore Hotel, Los Angeles, Calif., July 6-8.

• **National Housewares Manufacturers Association** — Convention Hall, Atlantic City, New Jersey, July 13-17.

• **Western Summer Radio-Television & Appliance Market**—Division of Western Home Goods Market, Western Merchandise Mart, San Francisco, Calif., July 20-24.

• **Southeastern Electric Exchange**—Personnel Administration Section, Grove Park Inn, Atlanta, Ga., July 30-31.

AUGUST

• **Hoosier Electronic Conference**—French Lick Sheraton Resort Hotel, French Lick, Ind., August 9-12.

• **International Association of Electrical Leagues**—24th Annual Meeting, El Cortez Hotel, San Diego, Calif., August 11-14.

• **International Association of Electrical Inspectors**—Northwestern Section, Seattle Hotel, Seattle, Wash., Aug. 24-26; Southwestern Section, Flamingo Hotel, Santa Rosa, Calif., Aug. 31- Sept. 2.

• **International Association for Hydraulic Research**—Eighth Congress, Montreal, Canada, Aug. 24-28.

• **Metallurgical Society of the American Institute of Mining, Metallurgical and Petroleum Engineers**—Statler Hotel, Boston, Mass., Aug. 31-Sept. 2.

SEPTEMBER

• **Illuminating Engineering Society**—Annual National Technical Conference, Fairmont and Mark Hopkins Hotels, San Francisco, Calif., Sept. 7-11.

• **Maryland Utilities Association**—Annual Fall Conference, The Cavalier, Virginia Beach, Va., Sept. 11-12.

• **National Electrical Contractors Association**—Annual Convention, Waldorf Astoria, New York City, Sept. 13-17.

• **Edison Electric Institute**—EEI-AGA Accounting Division & Section Organization Meeting, Hotel Cleveland, Cleveland, Ohio, Sept. 14-15; Meter and Service Committee, Hotel Wentworth, Portsmouth, N. H., Sept. 14-16; Industrial Power & Heating Group, Treadway Inn, Niagara Falls, N. Y., Sept. 17-18; Industrial Relations Committee Twelfth Annual Round Table Conference, Drake Hotel, Chicago, Ill., Sept. 21-23.

• **Electric Companies Public Information Program**—Workshop Conference, Warwick Hotel, Philadelphia, Pa., Sept. 16-17.

• **Northwest Public Power Association**—Power Use Workshop, Ephrata, Wash., Sept. 16-18; Accounting and Finance Workshop, Clark County PUD community room, Vancouver, Wash., Sept. 30-Oct. 1.

• **Public Utilities Association of the Virginias**—41st Annual Meeting, The Greenbrier, White Sulphur Springs, West Va., Sept. 17-19.

• **Instrument Society of America**—14th Annual Conference and Exhibit, International Amphitheatre, Chicago, Ill., Sept. 20-25.

• Additions this week.

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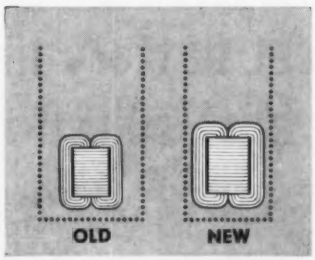

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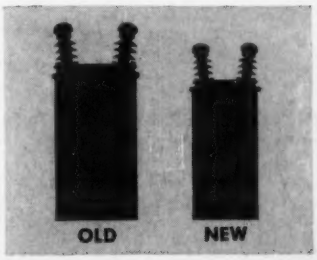

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